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BECKHAM (C. M.), HOUGH (W. S.) & HILL (C. H.). **Biology and Control of the Spotted Tentiform Leaf Miner on Apple Trees.**—*Tech. Bull. Va agric. Exp. Sta.* no. 114, 19 pp., 5 figs., 7 refs. Blacksburg, Va., 1950.

The following is largely based on the authors' summary of the results of investigations on the life-history and control of *Lithocolletis crataegella* Clem., which caused severe damage to apple in Virginia in 1944 and 1945. All stages are described. The larvae mine the leaves, causing the development of holes and shredded areas that give the foliage a ragged and scorched appearance from August until the end of the season. Adults emerged from pupae overwintering in leaves beneath apple trees at about the time the buds were in the delayed-dormant stage, and emergence continued for several weeks after the blooming period. In 1946 and 1948, peak emergence occurred when the blossom buds were showing pink and continued through the blooming period. Studies in 1946 indicated that there were three generations a year, the larvae being active chiefly in May, in late June or July, and in August–September, respectively. Most of the eggs were deposited singly on the under sides of the leaves, the females laying an average of 13·2 each. The larvae feed first on sap and later on the tissues of the leaves, and they develop and pupate entirely within the mines. Development was completed in 1946 in 45 days in the first generation, 41·2 in the second and 60·2 (for individuals giving rise to adults in autumn) in the third.

Natural enemies are important factors in control, and the outbreak in 1944 and 1945 is thought to have been largely due to their failure. The parasites observed in 1946–47 were, in order of decreasing importance, *Sympiesis lexingtonensis* Gir. and *S. nigripes* Ashm., which attacked the larvae and pupae, *Apanteles ornigis* Weed, *Cirrospilus nigrovariegatus* (Gir.) and *Zagrammosoma multilineatum* (Ashm.), which attacked the larvae, and *Horismenus violaceus* (Ashm.), which attacked the pupae. The Mirid, *Hyaliodes vitripennis* (Say), was predacious on the larvae.

In experiments on control by means of sprays, in which the amounts were per 100 U.S. gals. water, 1 pint nicotine sulphate was effective against the eggs and the larvae in the mines, but 1 lb. hexaethyl tetraphosphate did not kill the eggs. DDT at 1 lb. actual toxicant had little or no effect on the larvae, but destroyed the adults, and in cage tests the residues from this spray and one of 8 oz. actual DDT remained highly toxic to them for at least 17 days. Parathion at 8 oz. 25 per cent. powder also appeared effective against the adults and remained toxic in cage tests for at least 13 days. A single application of 0·5 or 1 U.S. pint nicotine sulphate in the first cover spray, about 8–19 days after petal-fall, controlled the insect throughout the season. Black Leaf 155, which contains fixed nicotine [14 per cent.] applied in this spray at 3 lb. was also effective. DDT at 1 lb. in the second to fifth cover sprays as recommended for the control of the codling moth [*Cydia pomonella* (L.)], also controlled *L. crataegella*, owing apparently to its toxicity to the adults.

Ière Conférence Internationale pour l'Examen des Moyens de Lutte contre les Parasites des Plantes du 3 au 6 Octobre 1950 à Rome. Allocutions, procès-verbal, rapports, communications et résolutions.—452 pp. Rome, Conf. int. Ingén. Tech. Agric., 1951.

Of the 50 reports and communications read at this Conference, the great majority are devoted to the control of insect pests of crops. The subjects dealt with include the use of modern organic insecticides, the history and organisation of plant protection in various countries and the standardisation of the chemicals used.

VAN EMDEN (F. I.). **A *Trox* Larva feeding on Locust Eggs in Somalia.**—*Proc. R. ent. Soc. Lond.* (B) **17** pt. 11–12 pp. 145–148, 5 figs. London, 1948.

Larvae of *Trox procerus* (Harold), were found feeding on eggs of *Schistocerca gregaria* (Forsk.) in Somalia in 1945. The characters differentiating larvae of the genus *Trox* from those of other Lamellicorns and larvae of *T. procerus* from those of some other species of the genus are described.

TAYLOR (G. G.). **Spray Treatments with DDT for Control of Codling Moth (*Cydia pomonella* L.) in Apple Orchards.**—*N.Z. J. Sci. Tech.* **33** (A) no. 4 pp. 60–65, 2 refs. Wellington, N.Z., 1951.

The following is based on the author's summary of this account of comparative field experiments with lead arsenate and DDT used as a wettable powder against *Cydia pomonella* (L.) on apple in 1945–49 in two districts in New Zealand; spray quantities are per 100 gals. water, and in the case of DDT refer to the p,p'isomer. DDT at 2 oz., applied at normal intervals throughout the season, gave control of *C. pomonella* comparable with that given by 2 lb. lead arsenate. Much improved control was secured with 4 oz. DDT, whilst higher dosages appeared to be unnecessary for practical purposes. It was shown that DDT sprays applied from January onwards were more important in the control of *C. pomonella* than applications made earlier in the season.

Where DDT was applied throughout the season, red-mite populations sometimes became heavy owing to eradication of predacious insects. It was shown that by using lead arsenate at 2 lb. up to mid-December and substituting 4 oz. DDT in later sprays, adequate control of *C. pomonella* was secured with minimum harm to beneficial predators.

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VAN DINTHER (J. B. M.). **Morphologie en biologie van de schildluis *Chionaspis salicis* L.** [Morphology and Biology of *C. salicis*.]—*Tijdschr. PlZiekt.* **56** pt. 3 pp. 173–252, 10 figs., 117 refs. Wageningen, 1950. (With a Summary in English pp. 242–246.)

In view of the lack of information on Coccids in Holland, a detailed study was made there in 1948–49 of *Chionaspis salicis* (L.), which in that country mainly infests willows (*Salix* spp.). Its distribution and synonymy are reviewed, a list is given of its recorded food-plants, and all stages are described in detail. The literature on the toxicity of modern contact insecticides to Coccids is reviewed.

C. salicis had one generation a year and overwintered in the egg stage beneath the scale of the parent female. In experiments, eggs were taken to the laboratory on 1st November, before the onset of autumn frosts, and stored at constant temperatures ranging from −1 to 13°C. [30·2–55·4°F.] and 90 per cent. relative humidity. Every ten days until February some were removed and kept at 18–19°C. [64·4–66·2°F.] until they hatched. The eggs stored at 13°C. hatched the most quickly, and those stored at 5°C. [41°F.] or below the most slowly, with little difference between the latter groups for equally long exposure to cold. A further test showed that the minimum temperature for hatching was 17–18°C. [62·6–64·4°F.]. The crawlers appeared on the trees in the second half of April, but did not become numerous until early May, and the first instar lasted about a month. The males pupated during the third week in June and gave rise to adults in early July. Both apterous and alate forms were observed, the former predominating. The females entered the third instar at the beginning of July, and scale formation began at about the time when the males emerged. The latter did not survive beyond a day, and reproduction was mainly parthenogenetic. The females oviposited in

September over a period of about three weeks. Development was more rapid in the laboratory, the females ovipositing in August. Numerous sterile females were observed, and there was a clear inverse relation between fertility and population density [*cf. R.A.E.*, A **22** 144]. On one branch, the number of eggs per female averaged 44·6 when all females were counted and 72 when sterile examples were excluded. In the laboratory the average number of eggs deposited daily by seven ovipositing females was 4–5 per individual.

The crawlers showed neither phototactic nor geotactic reaction, and did not leave the tree on which the parents had developed unless carried by wind or other agents. There were large fluctuations in the sex ratio among the offspring of individuals, but males and females were in general equally numerous. In experiments with other trees chosen mainly from the known food-plants of the Coccid, males developed on many of them, but females reached maturity and oviposited only on poplars (*Populus* spp.). *C. salicis* was parasitised by *Aphytis* (*Aphelinus*) *fuscipennis* (How.), which was the most important of the natural enemies observed, and by *Apterencyrtus* (*Chiloneurinus*) *microphagus* (Mayr), which was not common, and some of the eggs were destroyed by predacious mites. All stages of *Aphytis fuscipennis* are described, and a list of its alternative hosts is given. It had two generations a year, and though males were common, parthenogenesis occurred. Adults of the overwintered generation emerged and the females oviposited on the immature female scales during the second half of July, only one egg being laid on each. At 18–20°C. [64·4–68°F.], the egg, larval and pupal stages lasted about 5, 21 and 14 days, respectively. The adults emerged during September and oviposited on the mature females of *C. salicis*. Larvae from these eggs overwintered. The percentage parasitism throughout the year was about 14. The first generation effected the greater control as the hosts were killed before oviposition began, which was not always the case later in the year.

HILLE RIS LAMBERS (D.). **De nederlandse bladluizen van framboos en braam.** [The *Rubus* Aphids of the Netherlands.]—*Tijdschr. PlZiekt.* **56** pt. 3 pp. 253–261, 4 figs., 3 refs. Wageningen, 1950. (With a Summary in English.)

Raspberry and blackberry in Holland suffer much from virus diseases, some of which are apparently transmitted by Aphids. It is not known which Aphids are responsible, and the author therefore gives notes on the morphology and bionomics of those that breed on these plants in Holland.

The cycles of development recorded for *Amphorophora rubi* (Kalt.) and *Aphis idaei* v.d. Goot are similar to those described by Dicker in England [*R.A.E.*, A **28** 582–583]. *Amphorophora rubi* has been found only on raspberry and dewberry (*Rubus caesius*), the apterae are active and readily leave the canes when disturbed, and little or no damage is caused to the leaves. *Aphis idaei* has been found only on raspberry and causes considerable rolling of the leaves and twisting of the petioles, especially in early summer. The bionomics of *Aphis ruborum* (Börner), which has not been found on raspberry but is common on blackberry, are in the main similar to those of *A. idaei*, but numerous alates appear in the second generation of the year. It is thought that two forms may have been confused under the name *A. ruborum*, one of which infests blackberry throughout the year whereas the other migrates to alternative summer food-plants.

Macrosiphum funestum (Macch.) (*rubifolium* Theo.) occurs on wild blackberry in one district in Holland, and little is known of its bionomics there [*cf.* **28** 582]. Alates appeared in the third generation of the year and were present at least until the end of July. The Aphids are active. Winter eggs of *M. fragariae* (Wlk.) (*rubiellum* Theo.) have been found on blackberry, raspberry,

rose, *Agrimonia* and strawberry, but fundatrices have been observed only on blackberry. Hatching begins in February, and they are fully grown by mid-April. The third and succeeding generations are mostly alate, but include some apterae, which persist on blackberry probably until autumn. The alates migrate to succulent grasses (such as *Poa annua*), on which many successive generations are produced from mid-May. These include some alates, which fly to other grass plants. The return migration to blackberry occurs from the beginning of September. The ovipositing females that are produced on blackberry are fertilised by the males from grass and deposit about ten winter eggs each [*cf.* **28** 581]. There is no overwintering on grass. The Aphids cause some rolling of the leaves on blackberry, especially just before the spring migration.

M. (*Aulacorthum*) *solani* (Kalt.), *Myzus persicae* (Sulz.), *M. ornatus* Laing and *Aphis fabae* Scop. are also occasionally found on blackberry and raspberry, but do not appear to be of much importance.

The potentialities of the various Aphids as vectors of viruses of raspberry and blackberry are briefly discussed. The one most likely to be of importance in Holland is *Amphorophora rubi*, which is known to transmit raspberry viruses [*cf.* **38** 470].

McCallan (S. E. A.). **Factors influencing Deposition in the Vacuum Bell Jar Duster.**—*Contr. Boyce Thompson Inst.* **16** no. 1 pp. 27–37, 6 figs., 9 refs. Menasha, Wis., 1950.

The following is substantially the author's summary. A vacuum bell-jar duster was constructed following general principles already described [*R.A.E.*, A **37** 471], but modified to carry the samples of dust in movable 25 mm. watch glasses. The apparatus was also designed for use with a hood. Deposition was studied on bean plants, dusts mixed with a water-soluble dye being used. The dye was recovered from the deposited dust and measured in a colorimeter, and the amount of dust deposit was calculated from the results.

It was found that the deposit was directly dependent on the weight of the sample and the leaf area. It increased slightly with decrease in pressure within the bell jar, and a pressure of 240 mm. mercury was adopted as a standard. The height of the plant (distance from the dust sample) had no effect on the amount of deposit. The deposit on the lower surface of the leaf did not increase after about five seconds from the time of discharging the dust, but deposition on the upper surface sometimes continued for a minute or more, and five seconds was therefore taken as the standard exposure time. Ten different representative dust diluents were studied and found to differ considerably in dusting qualities and amount deposited. Satisfactory diluents are indicated.

The primary source of error was day-to-day variation in the experiments, which gave a coefficient of variation of 25 per cent., and the errors due to different plants and different leaves of the same plant contributed an additional 16 and 20 per cent. variation, respectively.

Jeppson (L. R.). **New Acaricides for Control of Citrus Red Mite, 1948–1950.**—*J. econ. Ent.* **44** no. 6 pp. 823–832, 1 graph, 5 refs. Menasha, Wis., 1951.

The following is largely based on the author's summary of this account of further investigations on sprays for the control of *Paratetranychus citri* (McG.) on *Citrus* in southern California [*cf. R.A.E.*, A **39** 337]. In field tests, p-chlorophenyl p-chlorobenzenesulphonate gave effective control of the eggs and newly hatched mites, but was relatively ineffective against the adults.

More consistent control was obtained as the dosage was increased from 2·5 to 16 lb. per acre, and there were no measurable differences in its duration whether the sprays were prepared from wettable powders or emulsion concentrates, though the latter gave higher immediate mortality. Except at excessive dosages, this material did not injure *Citrus*. At equivalent rates in ordinary dilute sprays and in semi-concentrate sprays applied with a spray-duster, it gave consistently more effective control than di(p-chlorophenoxy)methane, and the addition to it of comparatively small quantities of the latter, 2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite, parathion, tetraethyl pyrophosphate or tetraethyl dithiophosphate resulted in adequate initial kill of adults, but did not improve ultimate control. All stages of *P. citri* were affected by the sulphite, residues from which remained toxic to the adults for 32 days under certain field conditions. In general, more consistent control was obtained as the dosage was increased from 2 to 8 lb. per acre, and wettable powders were generally more effective than emulsion concentrates. Injury to *Citrus* was rare, but a slight pitting of young lemon leaves occurred in summer in coastal districts. At equivalent dosages, this compound was generally more effective than di(p-chlorophenoxy)methane, whereas 1,1-bis(p-chlorophenyl)ethanol, 2,4-dichlorophenyl benzenesulphonate, lauryl 2-thiazolinyl sulphide, p-chlorophenyl phenylsulphone and 4,6-dinitro-2-caprylphenylcrotonate were less so.

YUST (H. R.), FULTON (R. A.) & NELSON (H. D.). **Development and Stability of Resistance of California Red Scale to Fumigation with Hydrocyanic Acid.**—*J. econ. Ent.* **44** no. 6 pp. 833–838, 2 graphs, 4 refs. Menasha, Wis., 1951.

The experiments described were in continuation of those already recorded on Californian strains of *Aonidiella aurantii* (Mask.) resistant to fumigation with hydrocyanic acid gas [*R.A.E.*, A **32** 271] and were carried out mainly in 1948. From 1939, almost every generation of a culture of the original resistant strain on lemons was fumigated in the second-moult stage at dosages sufficient to kill at least half the individuals, and this is referred to as repeated fumigation. The stock had proved more difficult to kill after 14 repeated fumigations than the original resistant strain or stocks given seven repeated fumigations [*cf. loc. cit.*], and after 26 additional repeated fumigations, there was a further large increase in resistance. The median lethal dosage at 77°F. for second-moult scales was twice as great after 40 repeated fumigations as for the original resistant strain and that for mature females was increased significantly though much less. When second-moult scales were fumigated at 59°F., the median lethal dosage was five times as great after 43 repeated fumigations as for the original resistant strain. When subjected to prefumigation with 0·06 mg. HCN per litre, second-moult scales and males of this very resistant stock were as difficult to kill at 59 as at 77°F. The greatest increase in resistance was in the males at 59°, and they were more difficult to kill than the second-moult scales. Resistance to fumigation at 77°F. had also increased in other stages of the very resistant culture, except possibly in the mature females.

Further tests were carried out on the stability of acquired resistance. The original resistant and non-resistant strains were a little easier to kill in 1948 than they had been in 1938, after laboratory breeding for 49 generations without fumigation, but the differences between the strains were about the same on both dates ; the median lethal dosage for second-moult scales at 77°F. was about four times as great for the resistant strain as for the non-resistant strain. A resistant culture that received 14 repeated fumigations and was then reared for 27 generations without further fumigation retained much of the increased resistance acquired.

Scales were taken in 1945 from the grove from which the original resistant and non-resistant strains had been obtained, at least ten fumigations having been carried out in the ten years' interval. They proved more difficult to kill in the second-moult stage than the original resistant strain, but there was little difference in the mature females. Although the laboratory strain had become somewhat easier to kill during the interval, the difference was probably attributable to increased resistance resulting from the additional fumigations in the grove.

FORGASH (A. J.). **The Effect of Insecticides and other toxic Substances upon the reduced Glutathione of** *Periplaneta americana*.—*J. econ. Ent.* **44** no. 6 pp. 870–878, 5 graphs, 15 refs. Menasha, Wis., 1951.

Glutathione, a tripeptide composed of one molecule each of glutamic acid, cysteine and glycine, has been shown to be important in the life-processes of animals, and it has been suggested that its function is to maintain in their reduced form the -SH groups that are essential for the activity of certain enzyme systems. It is also possible that it functions as a co-enzyme in an oxidation-reduction system. It has further been suggested that the toxic action of arsenicals might be due to their affinity for -SH groups. Experiments have shown that the trypanocidal action of arsenicals is reversed as well as prevented by amorphous glutathione, cysteine and related -SH compounds, and that the reduced glutathione in insects of ten species is decreased as a result of injection of arsenic trioxide or arsenic pentoxide [*cf. R.A.E.*, A **16** 264].

A study was therefore made of the effect of certain toxic substances on the content of reduced glutathione (GSH) in adult males and females of *Periplaneta americana* (L.). The methods of preparing extracts and determining the material are described. The homogenates were allowed to stand for up to four hours, and it was then shown that normal males contained an average of 0·927 mg. GSH per gm. dry tissue and females 0·534 mg., the dry weights being 30·8 and 33·8 per cent., respectively, of the wet weights. However, subsequent to the writing of the paper, it was found that when the homogenates were allowed to stand overnight, the content was the same in both sexes. When toxic compounds were injected into the thoracic cavity of males, chlordan, p,p'DDT, parathion, nicotine, pyrethrins, rotenone, toxaphene, sodium fluoride and benzene hexachloride had no effect on the GSH content, whereas arsenic trioxide, dibasic sodium arsenate and cupric chloride decreased it. The injection of 0·008 cc. of a solution containing 0·875 mg. arsenic trioxide per cc. into the males caused the GSH content to diminish rapidly ; it reached a minimum 6–8 hours after injection and then increased gradually, reaching normal 24–48 hours after injection. When various dosages of arsenic trioxide were injected into the thoracic cavity of males and the GSH contents determined 16 hours later, plotting the percentage decrease against the dosage resulted in a curve that was almost a straight line, and this intersected the mortality curve for the same dosages at approximately 50 per cent. mortality and 50 per cent. inhibition, indicating that if glutathione in the reduced form is essential to the vitality of the insect, a considerable amount of the metabolite must be inhibited before death ensues. A similar relation between the two curves was found for both dibasic sodium arsenate and cupric chloride but not for ferric chloride, indicating that the modes of action of arsenic and copper are similar and that of iron different.

Comparison of the dosage-mortality and dosage-inhibition curves for arsenic trioxide in the females indicated that the action of arsenic on GSH is similar to that in the male, but that equivalent amounts of arsenic inhibit up to four times as much in the male as in the female. GSH injected into the insects

protected them against the toxic effects of arsenic trioxide. When it was introduced before the arsenic, it gave more than twice as much protection as when it was introduced after it.

JEFFERSON (R. N.) & EADS (C. O.). **Control of Aphids transmitting Stock Mosaic.**—*J. econ. Ent.* **44** no. 6 pp. 878–882, 5 refs. Menasha, Wis., 1951.

The method hitherto used in California for the control of mosaic diseases of annual stock (*Matthiola incana* var. *annua*), which cause breaking in colour of the flowers and are transmitted by Aphids [*cf. R.A.E.*, A **39** 450 ; **40** 64], has been to apply nicotine dusts against the vectors. Experiments were begun in 1947 to find a cheaper method and to determine whether insecticides that leave toxic residues would be more effective. The plant is a winter crop in southern California. Sprays and dusts were applied at intervals of about a week until the flower buds had set or were showing colour, and counts of affected and unaffected flowers were made for several weeks.

In 1947, dusts were applied nine times between 31st January and 31st March, and one consisting of 7·5 lb. BHC (benzene hexachloride) concentrate (5 per cent. γ isomer), 10·5 lb. diatomaceous earth and 32 lb. pumice resulted in significantly fewer affected flowers than one of 2·5 lb. technical chlordan, 25 lb. diatomaceous earth and 25 lb. pyrophyllite, which was itself significantly better than no treatment. Migrant Aphids, of which those collected were identified as *Myzus persicae* (Sulz.), were observed from mid-February to mid-March, but no Aphid colonies were found on the plants.

Sprays were applied 13 times between 8th December 1947 and 23rd March 1948. Parathion, used at 3 lb. 25 per cent. wettable powder per 100 U.S. gals. in the first six sprays and (because of plant injury) at 2 lb. in the remainder, gave consistent results and was apparently better than 2 lb. 12 per cent. γ BHC wettable powder or 1 U.S. pint nicotine sulphate and 1 U.S. gal. fish-oil soap per 100 U.S. gals., though the differences were not significant. Nine applications between 31st December 1948 and 16th March 1949 of wettable-powder sprays of 9·6 oz. 25 per cent. parathion, 2 lb. 12 per cent. γ BHC or 1–2lb. 25 per cent. lindane [containing at least 99 per cent. γ BHC] per 100 U.S. gals. or of BHC dust containing 0·75 per cent. γ isomer all caused significant reductions in affected flowers, with no significant differences between them. Migrants of both *M. persicae* and *Rhopalosiphum pseudobrassicae* (Davis) were taken during the spraying period, the latter being the more numerous, and a fortnight after spraying, there were 2·4–3·7 apterae per plant on treated plants as compared with 21·7 in the controls.

In 1950, when planting was late, sprays of 9·6 oz. 25 per cent. parathion powder, 4·8 fl. oz. Metacide emulsion concentrate containing 33·4 per cent. of a mixture of parathion and its methyl homologue, 1 lb. 25 per cent. lindane powder and 12 fl. oz. emulsion concentrate containing 20 per cent. tetraethyl pyrophosphate per 100 U.S. gals. were applied nine times between 4th March and 3rd May and one of 4·2 lb. technical schradan (octamethyl pyrophosphoramide) per 100 U.S. gals. three times. The incidence of mosaic was extremely high and no treatment gave any appreciable reduction. Collection of migrants between 30th March and 9th May showed that *R. pseudobrassicae* was again more numerous than *M. persicae*. In tests with potted plants in 1951, a 47·5 per cent. schradan emulsion concentrate (4 lb. active ingredient per U.S. gal.) diluted to 1 : 200 was effective against both Aphids, and sprays at half this strength also gave complete kill of *R. pseudobrassicae*, but permitted reinfestation sooner than the full dosage.

Soil from fields that had received about 20 lb. total BHC (6 lb. γ BHC) per acre in dusts or 18·5 lb. total BHC (5·5 lb. γ BHC) per acre in sprays applied 16 times during the winter of 1947–48, after which the fields were ploughed and

some replanted, was analysed spectroscopically in September 1948. No BHC was found in samples from depths of 10–20 ins., and 55·9 and 16 parts per million total BHC (16·5 and 5·4 p.p.m. γ BHC) in those from depths of 1–9 ins. in the two fields, respectively.

It is concluded that protection from mosaic may sometimes be obtained from frequent treatments against Aphids, but that when migrants are numerous, a high incidence of breaking may occur in spite of treatment, none of the materials acting rapidly enough to prevent transmission of the virus. Parathion, which seemed to be the best material tested, caused no plant injury at 0·15 lb. per 100 U.S. gals., and is so unstable in soil that there is little possibility of an accumulation of injurious residues. It gave good control of *R. pseudobrassicae*, which causes severe direct injury to small stock plants as well as transmitting the virus. BHC sprays and dusts caused slight stunting of the plants. The other materials did not injure plants in the field but schradan caused some marginal scorching of the leaves of potted stocks in the greenhouse.

METCALF (R. L.). **The colorimetric Microestimation of Human Blood Cholinesterases and its Application to Poisoning by organic Phosphate Insecticides.**—*J. econ. Ent.* **44** no. 6 pp. 883–890, 5 graphs, 21 refs. Menasha, Wis., 1951.

The following is based on the author's introduction and summary. The widespread use of parathion and other organic phosphate insecticides without adequate knowledge of their potential hazards has resulted in cases of human poisoning [*cf. R.A.E.*, A **39** 306], but it has been shown that they can be safely used if certain precautions are observed, such as the wearing of protective clothing, gloves and respirators, and if periodic tests are made for dangerous levels of over-exposure by measurement of the cholinesterases of the blood. In this paper, the author describes some of the results of a two-year study of blood-cholinesterase levels of persons working with organic phosphate insecticides.

A rapid and precise colorimetric method that can be used with as little as 1 mml. plasma was developed for the determination of human-plasma and red-cell cholinesterases in blood from a finger-tip puncture. The conditions for its satisfactory performance are outlined, and values are presented for expected normal variations in a single subject and in a group of males. It is being used in the United States as a routine method to detect possible dangerous levels of over-exposure, and a summary is given of the various types of anticholinesterases that may be encountered and their effects on blood cholinesterase.

BARTLETT (B. R.). **The Action of certain "inert" Dust Materials on parasitic Hymenoptera.**—*J. econ. Ent.* **44** no. 6 pp. 891–896, 31 refs. Menasha, Wis., 1951.

In the experiments described, which were carried out in California to ascertain the action on Hymenopterous parasites of inert dusts such as are used as diluents in insecticidal dusts or sprays [*cf. R.A.E.*, A **30** 196], adults of *Aphytis chrysomphali* (Merc.) and *Metaphycus luteolus* (Timb.) were confined in small cages over dry deposits of 27 materials, thin films of honey being supplied as food. The periods required for 50 per cent. mortality were determined, and the results showed that all materials of mineral origin killed both species rapidly, the thin-cuticled *Aphytis* being much more susceptible than the more heavily chitinised *Metaphycus*. Plant materials had little lethal effect, though they adhered to the insects tenaciously. No correlation was apparent between killing action and chemical properties, but average particle size of mineral dusts was inversely correlated with mortality. There was no

evidence that materials having acicular or sharp-edged particles were more harmful than those composed of smoother particles or existing as rounded aggregates. A few materials, such as calcite and calcium-lime products and sulphurs appeared to vary slightly in effect from what would be expected on the bases of physical characteristics alone. Bentonites caused a rapid kill in the early exposure periods, but survivors appeared little affected by further exposure.

Field experience indicates that many dust materials are less harmful to parasites after having been wetted, and in a further cage test on *Aphytis*, calcite, fine sulphur, diatomite, pyrophyllite and attapulgite all lost a large part of their effect after being wetted enough to simulate heavy dewfall 24 hours before testing and regained only a small part of it when subsequently kept at 50 per cent. relative humidity for 35 days ; sulphur, which is comparatively harmless as a dry powder, showed least change after atomisation with water. No apparent reduction in adhesion of dust particles to the insects could be observed when the dusts were atomised with a fine mist of water 24 hours before the tests, and insects that were almost inactivated by the action of dry dusts could be revived to nearly natural existence and longevity by bathing them in clear water to remove all dust particles.

The facts that materials having low water-adsorptive or -absorptive capacities, such as plant products, had less adverse effect than others and that most dry powders killed the parasites by gradually weakening them indicate that the lethal action of inert dusts is due to desiccation of the insects. This did not appear to be necessarily due to epicuticular abrasion [*cf.* **38** 352, etc.].

ZEID (M. M. I.) & CUTKOMP (L. K.). **Effects associated with Toxicity and Plant Translocation of three Phosphate Insecticides.**—*J. econ. Ent.* **44** no. 6 pp. 898–905, 6 graphs, 11 refs. Menasha, Wis., 1951.

The results are given of greenhouse and laboratory experiments on the translocation of schradan (octamethyl pyrophosphoramide), paraoxon (O,O-diethyl O-p-nitrophenyl phosphate) and parathion in actively growing broad-bean plants and leaves of broad bean and sweet maize. The compounds were dissolved in acetone, and a wetting and emulsifying agent (Triton X-100) was added. Translocation was measured by toxicity of the plants or leaves to *Tetranychus bimaculatus* Harvey and the toxicity of extracts from the leaves to larvae of *Aëdes aegypti* (L.) ; extraction was carried out with benzene, the extract was evaporated to dryness and redissolved in acetone and aliquots of the acetone were diluted in water and used for testing [*cf. R.A.E.*, A **39** 6]. Preliminary tests with pure schradan and paraoxon dispersed from acetone into water showed that concentrations of 0·95 and 0·016 part per million, respectively, gave 90 per cent. kill of the mosquito larvae.

On bean leaves with the cut ends immersed in dispersions of 0·05 per cent. paraoxon, schradan and parathion, mite mortality was complete in 12, 24 and 30 hours, respectively. The speed of action was less in maize leaves, possibly because the mites were further from the source of the insecticide, and this suggested that fumigant action might be involved as well as translocation. When a sprayed and an unsprayed bean plant were infested with the mite and placed under a bell jar with the leaves not touching, vapour toxicity was marked for parathion, somewhat less for paraoxon and negligible for schradan. An experiment in which the insecticides were applied in sprays to the upper leaves of bean plants, and extracts of the lower leaves made five hours later were tested against mosquito larvae, indicated a recovery of 2–2·2 per cent. of the paraoxon applied (or resultant toxic material) and of 7·6–8 per cent. of the schradan, whereas the reverse process resulted in only one-tenth of these values, so that the translocation of the compounds in the plants was greater

in the downward direction [but *cf.* **39** 428]. This was confirmed by tests in which mites were put on the unsprayed leaves of partly sprayed plants at various intervals, and it was further shown by this method that a maximum of 40 per cent. of the schradan applied and 7 per cent. of the paraoxon was present in unsprayed lower leaves 12 days after spray applications to the upper ones. All three materials were translocated in this way, schradan the most and parathion the least readily, and schradan was the most persistent, giving complete mortality for more than four weeks when applied at 0·05 per cent., whereas parathion and paraoxon did so for only 12 and 14 days, respectively. There was no evidence of translocation of parathion, paraoxon or schradan in bean plants in flower.

Both schradan and paraoxon sprays caused an increase in the carbohydrate content of bean plants, the increase being greater for schradan and greater for both in sunlight than in the dark. A preliminary test also indicated that the nitrate content of pea and bean plants increased after treatment with schradan. This is of some practical importance, as cattle feeding on plants with a high content of nitrates may have a bacterial conversion of nitrate to toxic nitrite compounds. A nitrate concentration of more than 1·5 per cent. in edible plants may result in livestock poisoning.

ANDERSON (L. D.), REYNOLDS (H. T.), HASHE (J. W.) & SWIFT (J. E.). **Studies on Control of Corn Earworm on Sweet Corn in southern California in 1949.**—*J. econ. Ent.* **44** no. 6 pp. 905–909, 5 refs. Menasha, Wis., 1951.

The following is substantially the authors' summary. In 1949, 22 experiments were carried out in continuation of work on the control of *Heliothis armigera* (Hb.) on sweet maize in southern California [*cf. R.A.E.*, A **38** 363]. Spraying individual ears with an emulsion containing 1 per cent. DDT and 5–10 per cent. mineral oil gave 92–95 per cent uninfested ears, injection of 1 per cent. DDT in oil into the ears 91 per cent., individual ear treatments with 3 per cent. DDT dust 79–82 per cent. and broadcast DDT-dust treatments only 26 per cent., as compared with 3 per cent. for no treatment. The injection of insecticides injured the silks and should be delayed until after pollination. Occasional ear injury resulted from the oil-emulsion sprays, but no plant damage was caused on dusted maize.

Dusts containing 3–5 per cent. DDT gave better protection than dusts containing 1 per cent. parathion, 5 per cent. DDD (dichlorodiphenyldichloroethane), 40 per cent. *Ryania*, 5 per cent. methoxy-DDT (methoxychlor), 1 per cent. lindane [at least 99 per cent. γ benzene hexachloride], 0·5 per cent. dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] or 1 per cent. aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene]. At least three applications of DDT dust at intervals of not more than three days, beginning within a day or two of the appearance of the silks, were necessary for the best results. DDT applied in dusts or sprays or by injection did not leave significant residues on the edible portion of the ear, but husk and silk refuse from treated ears contained 46–208 parts DDT per million.

ROGOFF (W. M.) & METCALF (R. L.). **Some insecticidal Properties of Heptachlor.**—*J. econ. Ent.* **44** no. 6 pp. 910–918, 26 refs. Menasha, Wis., 1951.

The authors review information on the insecticidal activity and related characteristics of heptachlor (1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene) published during the last few years, describe its chemical and physical properties and give the results of tests on its stability, solubility and toxicity to various insects. The following is based on their summary.

Heptachlor proved more stable to the action of alkali than chlordan or DDT and somewhat more soluble than DDT in organic solvents. It was more toxic than chlordan or DDT to *Entomobrya* sp., *Heliothrips haemorrhoidalis* (Bch.), *Blattella germanica* (L.), *Pogonomyrmex barbatus* (F.Sm.), *Tribolium confusum* Duv., *Lucilia* (*Phaenicia*) *sericata* (Mg.), *Drosophila melanogaster* Mg. and larvae of *Phryganidia californica* Pack., and as toxic as aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] but rather less toxic than dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene], γ BHC (benzene hexachloride) or parathion to *Rhagoletis suavis completa* Cress. It was equivalent in toxicity to chlordan but more toxic than DDT to larvae of *Apantesis proxima* (Guér.) and adults of *Listroderes obliquus* Gylh., and equivalent to chlordan but less toxic than DDT to larvae of *Tortrix* (*Archips*) *argyrospila* (Wlk.). Heptachlor was as toxic as aldrin and dieldrin but less so than γ BHC or parathion to *Musca domestica* L., and as toxic as parathion and more toxic than any other compound tested to *Dacus ferrugineus dorsalis* Hend. It was ineffective against *Paratetranychus citri* (McG.) and crawlers of *Aonidiella aurantii* (Mask.) and less repellent to *H. haemorrhoidalis* than DDT or chlordan but more so than dimethyl phthalate.

The diffusion or translocation of heptachlor from the upper to the lower surface of avocado leaves was demonstrated, and fumigant action was shown for this compound, chlordan and γ BHC, but not for DDT.

Smith (W. R.) & Calhoun (S. L.). **Spraying for early-season Control of Boll Weevil.**—*J. econ. Ent.* **44** no. 6 pp. 919–920, 4 refs. Menasha, Wis., 1951.

Tests were made in 1949 near Rolling Fork, Mississippi, on the effect of toxaphene sprays applied to cotton for the control of *Anthonomus grandis* Boh. early in the season, the cost of application and the feasibility of combining insect control with regular crop cultivation. Parts of nine fields showing heavy populations of overwintered weevils were sprayed with 0·8 lb. toxaphene in 1·4 U.S. gals. emulsion per acre during each cultivation, 2–4 applications being made between 20th June and 11th July, and infestation records were made weekly from 29th June. Poison applications were resumed on 20th July, when infestation in the treated parts of the fields had reached 25 per cent., an average of 6·5 applications per field of a toxaphene emulsion being made by aeroplane at the rate of 2–2·5 lb. in 2 U.S. gals. liquid per acre to the entire fields at intervals of 4–8 days, depending on the weather. The pre-bloom and early-bloom sprays resulted in an average delay of 19 days in the date at which 25 per cent. of the squares became infested and cost less than applications during the 19 days would have done. There was a significant increase in yield of seed cotton in six of the fields treated during the pre-bloom stage. Most of the crop in all but three fields was set early in the season, and much of the expenditure on control after 20th July was wasted because of adverse climatic factors.

Summers (F. M.). **Tests of new Materials to control Peach Twig Borer on Almonds and Peaches.**—*J. econ. Ent.* **44** no. 6 pp. 935–939, 2 refs. Menasha, Wis., 1951.

Small populations of *Anarsia lineatella* Zell. are almost always present in stone-fruit orchards throughout much of California, and although the use of sprays of basic lead arsenate has given reasonably satisfactory protection against outbreaks, a number of recently developed insecticides were tested on young almond and peach trees in an attempt to improve control. Dormant oil, tetraethyl pyrophosphate, di-2-ethylhexyl phthalate, sodium pentachlorophenate and dinitrocaprylphenylcrotonate had little or no effect, and chlordan,

benzene hexachloride, toxaphene, methoxy-DDT (methoxychlor), aldrin [1,2,3,4,10,10 - hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4,5,8 - diendomethanonaphthalene], dieldrin [1,2,3,4,10,10 - hexachloro - 6,7 - epoxy - 1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene], dicyclohexylamine dinitro-o-sec.-butylphenate and dicyclohexylamine dinitro-o-cyclohexylphenate had a poor or moderate effect, whereas parathion, DDT and triethanolamine dinitro-o-sec.-butylphenate gave excellent results.

The last killed a high proportion of overwintering larvae within their hibernacula and also gave excellent control of *Bryobia praetiosa* Koch when applied to semi-dormant almond trees at a concentration of 1 lb. per 100 U.S. gals. spray. Parathion, alone or in multi-purpose sprays containing fixed copper fungicides or dormant oil, was very effective against overwintering larvae when applied to almonds at the dormant, delayed-dormant or petal-fall stages, and comparable results were obtained with pink-bud and petal-fall sprays applied to peaches. Parathion sprays applied against this generation in the pre-bloom and petal-fall periods were as effective as well-timed applications of the same material against larvae of the first generation in May. Consistently good results were also obtained with DDT sprays applied at various intervals from the dormant stage until May. In two series of tests, DDT at 2 lb. 50 per cent. wettable powder per 100 U.S. gals. spray and parathion at 2 lb. 25 per cent. wettable powder per 100 U.S. gals. were both superior to 4 lb. basic lead arsenate per 100 U.S. gals. when applied under comparable conditions, but the substitution of the new materials for lead arsenate cannot be recommended on the basis of these limited tests.

COCHRAN (J. H.). **Tests with Dusts against Plum Curculio.**—*J. econ. Ent.* **44** no. 6 pp. 940–942, 1 ref. Menasha, Wis., 1951.

An account is given of investigations on dusts for the control of the plum curculio [*Conotrachelus nenuphar* (Hbst.)] on peach in South Carolina. In one test in the laboratory, 5 per cent. EPN (ethyl p-nitrophenyl thionobenzenephosphonate), dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] and Compound 1189 (an oxygenated dimer of hexachlorocyclopentadiene) all gave more than 80 per cent. kill in 72 hours of adults caged with dusted twigs, whereas 5 per cent. aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], Dilan [a 2 : 1 mixture of 1,1-bis(p-chlorophenyl)-2-nitrobutane and 1,1-bis(p-chlorophenyl)-2-nitropropane], 2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite, methoxy-DDT (methoxychlor) or toxaphene and a mixture of 3 per cent. γ BHC (benzene hexachloride) and 5 per cent. DDT gave less than 7 per cent., and in another, 1 per cent. tetraethyl pyrophosphate, parathion, dieldrin, EPN and Compound 1189 gave 6·6, 100, 26·6, 100 and 73·3 per cent., mortality, respectively, indicating that parathion and EPN were outstandingly more effective than any other material tested. There were no significant differences in initial toxicity between three dusts containing about 60–75 per cent. sulphur and 1 or 1·5 per cent. parathion, and such materials lost little of their potency when stored in unopened kraft-paper bags for over a year.

In a field test in 1950, a spray containing 10 lb. per 100 U.S. gals. of a mixture of parathion, sulphur and inert material (2·2 : 40·8 : 57), applied by a speed-sprayer at petal-fall, shuck-fall and in four cover sprays, reduced the numbers of dropped fruits per tree and the percentages infested more than did seven applications of dusts containing sulphur and 1 or 1·5 per cent. parathion or two spray applications of BHC followed by four of lead arsenate, with DDT in the last two, but the dusts appeared to be as effective as the sprays at harvest.

FARRAR (M. D.) & REED (J. K.). **Methods for Evaluation of Cotton Insecticides.** —*J. econ. Ent.* **44** no. 6 pp. 943–945, 2 figs., 2 refs. Menasha, Wis., 1951.

As field control of *Anthonomus grandis* Boh. on cotton by the new organic chlorinated insecticides is much affected by the composition and physical properties of dusts, the density of the insect population and the weather, laboratory techniques were developed in South Carolina to standardise such factors and thus obtain more accurate determinations of toxicity. The dusts were applied to cotton plants by means of a modified precision vacuum duster [*cf. R.A.E.*, A **40** 100], using a bell jar with a capacity of 1 cu. ft. A potted cotton plant was put in the jar with 25 mg. dust in the watch glass, a vacuum of 20 ins. mercury was drawn and released to disperse the dust, and the plant was then left in the jar for up to five seconds, so as to obtain a uniform deposit of dust on the upper and lower surfaces of the leaves [*cf. loc. cit.*], after which it was put in a shallow tray of water and adult weevils caged on it for 72 hours. Care was taken that the dust samples, plants and insects should be uniform; the last were obtained from fallen squares collected in the field and were used three days after emergence.

In spite of efforts to ensure uniformity, the daily changes of weather affected the kill, and it was therefore necessary to include a standard reference dust, for which one containing 3 per cent. γ benzene hexachloride and 5 per cent. DDT was selected, in every series of tests. Preliminary experiments showed that a dosage of 25 mg. dust per test gave an average mortality of 70–80 per cent., which gave a better separation between dust samples than the median lethal dosage. All the dusts tested, including calcium arsenate, 20 per cent. toxaphene and mixtures of 5 per cent. DDT with 10 per cent. chlordan or 2·5 per cent. aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], some with 40 per cent. sulphur included, could be compared at this dosage without adjustment.

MAYER (E. L.), NELSON (R. H.), WOODWARD (C. F.) & WILLAMAN (J. J.). **Effect of the Ratios of Nicotine to Bis(p-chlorophenyl) Sulfide and Bis(p-chlorophenyl) Disulfide on Synergism.**—*J. econ. Ent.* **44** no. 6 pp. 946–949, 2 graphs, 3 refs. Menasha, Wis., 1951.

In further attempts to find synergists for nicotine [*cf. R.A.E.*, A **39** 117], nicotine alkaloid and nicotine sulphate were prepared as dusts by deposition from a solvent on bentonite and attapulgite, respectively, and combined with various proportions of di(p-chlorophenyl) sulphide or di(p-chlorophenyl) disulphide. Sprays with the sulphide were also prepared. The insects tested were third-instar larvae of *Leucania* (*Cirphis*) *unipuncta* (Haw.), *Plutella maculipennis* (Curt.) and *Gastrophysa cyanea* (Melsh.), fourth-instar larvae of *Phryganidia californica* Pack., second-instar nymphs of *Macrosiphum pisum* (Harris) (*pisi* (Kalt.)) and all stages of *Aphis fabae* Scop. The Lepidopterous and Coleopterous larvae were enclosed with treated foliage of their food-plants, and the Aphids were dusted on leaves.

In the tests with dusts, nicotine sulphate was used with the sulphide against all insects and with the disulphide against *Leucania* and *Plutella*, and nicotine alkaloid was used with the sulphide against these two and *A. fabae*. The sprays were tested against *Leucania* only. The results were analysed according to the short method previously described [*loc. cit.*] and are given in tables. Synergistic effects were shown against all insects, and they were greatest for the sulphide and nicotine sulphate against *Leucania*, *Plutella* and *M. pisum* and for the sulphide and nicotine alkaloid against *Plutella*. Against *Leucania*, the most effective ratios of nicotine to the sulphide were those between 0·05 : 1 and 1·5 : 1, with a peak at 0·25 : 1, and the most effective ratios of nicotine

to the disulphide were 0·25 : 1 and 1 : 1. In the spray tests, synergism was demonstrated between nicotine sulphate and the sulphide only in the low ratio of 0·05 : 1, but there was a high degree of synergism between nicotine alkaloid and the sulphide at all ratios tested.

In experiments made once a week for five consecutive weeks to determine the effect of feeding on maize and barley on the susceptibility of *Leucania*, mixtures of nicotine sulphate and the sulphide showed higher synergism at the ratio of 0·25 : 1 than at 1·5 : 1 and higher synergism for each mixture on maize than on barley. The effect of food was also apparent when *A. fabae* was fed on rhubarb and on nasturtium ; significant synergism was observed on the first, but not on the second. Data obtained between February and July showed no consistent seasonal effect on synergism against *Leucania*.

WALTON (R. R.). **Control of the Red-necked Cane Borer on prostrate Brambles by Summer Pruning.**—*J. econ. Ent.* **44** no. 6 pp. 950–954, 1 graph, 2 refs. Menasha, Wis., 1951.

The following is substantially the author's summary. *Agrilus ruficollis* (F.) is the most important insect pest of brambles in Oklahoma, and is particularly injurious to those of the prostrate type, such as boysenberries and youngberries. Observations on the seasonal history and control of the Buprestid on these two were made in 1945–49. Larvae appeared in the new canes in April, pupae occurred from early April to early June, and adults were present from early May to mid-July. They survived for an average of 18 days and a maximum of 34. Infestations were satisfactorily controlled by cutting off the spring canes and thereby causing the development of a second set of canes that appeared after most of the eggs were laid. Pruning was more effective after than before harvest (99 and 94 per cent. reduction in infested canes, respectively). Under the dry conditions prevailing in nearly all the tests during the late summer and early autumn, post-harvest pruning reduced the yields markedly, as contrasted with earlier pruning, but in irrigated plantings there was no important difference. Post-harvest pruning was simpler and less expensive than the other method, and also appeared to restrict the spread of bramble anthracnose from the old canes to the new.

DAHMS (R. G.). **Insecticide Formulations and Equipment used for Greenbug Control.**—*J. econ. Ent.* **44** no. 6 pp. 954–957. Menasha, Wis., 1951.

The following is based on the author's summary. Sprays and dusts containing various insecticides, applied by several methods, were tested in Oklahoma in 1949–50 for the control of *Toxoptera graminum* (Rond.) on cereals, including wheat and oats. Parathion dusts and sprays applied with hand equipment at 0·16 lb. or more of the toxicant per acre gave much better control than BHC (benzene hexachloride) at 0·69 lb. γ isomer. Metacide (a proprietary emulsion concentrate containing a 1 : 4 mixture of parathion and its methyl homologue) and parathion, applied at 0·28 and 0·24 lb. toxicant per acre, respectively, in 50 U.S. gals. water with a high-pressure sprayer, gave good control, but TEPP (tetraethyl pyrophosphate) at 0·3 lb. and BHC at 0·37 lb. γ isomer per acre applied by the same method were ineffective. A low-volume sprayer without mechanical agitation was not satisfactory for applying parathion suspensions, but Metacide and parathion emulsions gave good results when applied by this method at approximately 0·25 lb. toxicant per acre. A side-delivery mist blower was satisfactory for parathion when the wind velocity was below 7 miles per hour, but a fishtail assembly was necessary for good results at higher wind velocities. Lindane [at least 99 per cent. γ BHC] gave satisfactory control in emulsions applied with a mist-blower, but not in those applied with a low-volume sprayer.

When applied from an aeroplane at about 0·25 lb. toxicant per acre, parathion and Metacide emulsions gave good control, but TEPP was unsatisfactory. Applications of 0·2 lb. parathion and 0·88 lb. γ BHC per acre with a power duster gave about 90 per cent. reduction in population, but a lower dosage of BHC, alone and in a mixture with DDT and sulphur, gave reductions of less than 75 per cent., as also did a pyrethrum dust.

CARLSON (E. C.), LANGE jr. (W. H.) & SCIARONI (R .H.). **Distribution and Control of the Cabbage Seedpod Weevil in California.**—*J. econ. Ent.* **44** no. 6 pp. 958–966, 3 figs., 10 refs. Menasha, Wis., 1951.

The authors summarise the distribution of *Ceuthorrhynchus assimilis* (Payk.) on cruciferous seed-crops in the United States [*cf. R.A.E.*, A **39** 20] and Canada [*cf.* **35** 34], describe investigations in 1950 on its distribution and control in California and review the life-history of the weevil in that State. Pod counts showed that of the most important seed-producing counties, San Mateo, Santa Cruz and Santa Clara, in the central coast area, were heavily infested, whereas Monterey was not much affected. The weevil was numerous on wild crucifers [*cf.* **37** 290] in Contra Costa and Monterey counties. There were considerable local variations in the intensity of infestation. In the central coast area, the adults leave their hibernation quarters in débris and soil between late March or early April and the end of June. They feed on the flowers, without causing much damage, and pair, and the females deposit eggs singly in the developing seed pods [*cf.* **35** 300]. The larvae hatch in a few days and feed within the pods for about three weeks, attacking 5–6 seeds each, and then pupate in the soil. Adults emerge about two weeks later and feed on the late succulent pods, stems and leaves from May to August, so that there is considerable overlapping of adults of two seasons. Only one generation is produced a year, however. The main damage is that caused by the larvae.

The experiments on control were carried out on brussels sprouts in two areas to test the value of dusts of BHC (benzene hexachloride), aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene]. In the first, 1 per cent. lindane [at least 99 per cent. γ BHC], technical BHC or aldrin, applied six times at weekly intervals from 7th April and once more on 29th May, reduced the percentages of pods infested to 2·5, 1 and 1 and the percentage seed loss to 0·47, 0·14 and 0·25, respectively, as compared with 13·5 and 3·82 for untreated plants exposed to considerable dust drift and 20 and 7·81 for those exposed to less. Seed setting was not affected. In the second experiment, seven applications of 1 per cent. technical BHC or dieldrin at about weekly intervals from early April entirely prevented infestation, which was moderately heavy in the controls. BHC gave good control of a heavy population of *Brevicoryne brassicae* (L.) on the plants, but this Aphid was not affected by dieldrin.

Parasites observed in the area in which the first experiment was carried out comprised *Xenocrepis pura* Mayr, which was the most important, *Amblymerus mayetiolae* (Gah.) and *Trimeromicrus maculatus* Gah. These Pteromalids feed ectoparasitically on the weevil larvae in the pods, and they were absent from the experimental plots, though parasitism on heavily infested neighbouring wild yellow mustard (*Brassica campestris*) reached 27·2 per cent. As they were presumably repelled or killed by the residues, it is desirable to use the insecticides least toxic to parasites and to make as few applications as possible consistent with economic control. Satisfactory control by parasites is difficult to obtain in areas containing numerous wild food-plants and commercial seed plantings, but parasites should be encouraged. A survey made in 1951 in the north of San Joaquin County, where wild yellow mustard was heavily infested, showed

that 11·1 per cent. of the weevil larvae were parasitised, *X. pura*, *T. maculatus*, and one example each of *Trichomalus fasciatus* (Thoms.) and *Spilochalcis side* (Wlk.) being reared from them.

Sampling of commercially dusted plantings of brussels sprouts in 1950 showed an average of 95·07 per cent. control by 1 per cent. technical BHC applied at intervals of 7–10 days during the period of seed development, with no decrease in fertilisation. Parasites, which were not effecting control, were repelled or killed. As there is some danger of the accumulation of injurious residues in the soil, lindane is considered a safer material for use than technical BHC. Four applications at intervals of 10–12 days from the time the first pods begin to develop should give adequate protection.

Anderson (L. D.), Bacon (O. G.), Reynolds (H. T.) & Swift (J. E.). **Investigations of Corn Earworm Control on Sweet Corn in California in 1950.**—*J. econ. Ent.* **44** no. 6 pp. 966–971, 5 refs. Menasha, Wis., 1951.

The authors discuss the variations in population density of *Heliothis armigera* (Hb.) on sweet maize in the United States and point out that practical control (90 per cent. kill) of moderate populations averaging one larva or less per ear can be obtained with many current DDT dust or spray treatments, but that practical control of heavier populations requires methods giving nearly complete kill. In tests against moderately heavy populations in California, dusts applied by hand with a 1- or 1·5-inch stencil paint brush, which was dipped in dust carried in a wide-mouthed container and then thrust into the silks of the ear to be treated, gave good results. Treatment by this method should be begun within one day after the appearance of the silk and repeated 3–4 times at intervals of not more than three days, even though considerable visible deposit remains from the previous application. When the maize is silking over a long period more than four applications may be needed. The treatment was applied extensively with no injury to pollination, and no insecticidal residue was found on the edible parts of the ears, though there were considerable residues on the husk and ear refuse. The effect of rainfall on the treatment is not known.

When dusts were applied by this method in 1950, 5 per cent. DDT gave an average of 91·5 per cent. uninfested ears, and 5 per cent. of a 1 : 2 mixture (Dilan) of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane and 5 and 10 per cent. 2,2-bis(p-ethylphenyl)-1,1-dichloroethane, which are reported to have a low toxicity to mammals, gave promising results. Frequent applications of DDT dust by aeroplane, helicopter or ground-power dusters gave poor control or none. A spray containing 0·75 per cent. DDT from an emulsifiable solution and 10 per cent. mineral oil was ineffective when applied by aeroplane and only fairly effective when applied by a fixed-boom ground sprayer at the rate of 25–50 U.S. gals. per acre 3–4 times at three-day intervals from the first appearance of the silks, but this mixture, and a similar one containing only 5 per cent. oil, gave about 95 per cent. uninfested ears when applied to individual ears with a trigger-operated paint spray gun at not more than 1·5 cc. per ear. Two applications at 5-day intervals were necessary for each ear, or more if the silking period was extended, the first being made a few days after the appearance of the silk, but precise timing was less necessary for the spray than for the dust. Heavier applications of spray sometimes caused scorching and disfiguration of the husk, but did not appear to reduce pollination seriously or to disfigure the ear inside the husk. When a DDT wettable paste was substituted for the emulsifiable solution, the percentages of uninfested ears fell to about 90, but there was no plant injury. Injection of 1 per cent. DDT in mineral oil into the ears gave only 80 per cent. uninfested ears, and injections of Tartar emetic in water or pyrethrum or allethrin [synthetic allyl homologue of cinerin I] in oil were still less effective.

RAINWATER (C. F.) & GAINES (J. C.). **Seasonal Decline in the Effectiveness of certain Insecticides against Boll Weevil.**—*J. econ. Ent.* **44** no. 6 pp. 971–974, 4 refs. Menasha, Wis., 1951.

Field-cage tests carried out at College Station, Texas, in 1948–50 confirmed previous observations that insecticides are less effective against adults of *Anthonomus grandis* Boh. on cotton late in the season than they are earlier [*cf. R.A.E.*, A **39** 391]. In 1950, dusts of toxaphene, BHC (benzene hexachloride), aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] were about half as effective in October as in July and undiluted calcium arsenate was about 67 per cent. as effective, and in all three years, there were fairly regular decreases each month between June and September (as far as the data were available) in the toxicity of toxaphene, calcium arsenate and a mixture of 3 per cent. γ BHC, 5 per cent. DDT and 40 per cent. sulphur. Increased concentrations and increased dosages of toxaphene, BHC, aldrin, dieldrin or calcium arsenate up to four times the normal rate of application did not significantly increase the percentage kill in October, and laboratory tests in which chlordan and parathion were also included showed that very greatly increased dosages of all these materials would be required to effect high mortality in October as compared with those necessary in July, that for toxaphene being 240 times as great.

In greenhouse tests to compare the effectiveness of dust residues, aldrin and BHC lost 66 and 58 per cent. of their effectiveness within one day, and heptachlor [1 (or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene], dieldrin and toxaphene lost 39, 32 and 45 per cent., respectively. Calcium arsenate lost no effectiveness in one day and EPN (O-ethyl O-p-nitrophenyl thionobenzenephosphonate) only 2 per cent. After five days, the chlorinated hydrocarbons were virtually ineffective.

LINDGREN (D. L.) & VINCENT (L. E.). **Relative Toxicity of Fumigants to *Tribolium confusum* and *Sitophilus granarius* in Wheat.**—*J. econ. Ent.* **44** no. 6 pp. 975–979, 5 refs. Menasha, Wis., 1951.

The following is substantially the authors' summary. An account is given of experiments in which 16 compounds and mixtures were tested as fumigants against adults of *Tribolium confusum* Duv. and *Calandra* (*Sitophilus*) *granaria* (L.) in lots of 30 lb. wheat contained in 28-litre sealed cans, which they filled to a height of 8 ins. The insects were caged at the surface of the wheat and at depths of 2 and 5·5 ins., and the fumigants were applied from a microburette to the surface of the grain.

The exposure was for 24 hours, and the temperature 86°F. Against *T. confusum*, methyl bromide was the most and carbon tetrachloride the least effective at all three levels, and both were rather more effective at the greatest depth than at the surface. All other compounds and mixtures gave the best results at the surface, hydrocyanic acid gas requiring more than 15 times the surface dosage to give 95 per cent. kill at 5·5 ins. Of the mixtures, that of acrylonitrile and carbon tetrachloride (1 : 1) was the most toxic at all depths.

Against *C. granaria*, methyl bromide was the most effective, closely followed by acrylonitrile, and carbon tetrachloride was the least effective. Both methyl bromide and carbon tetrachloride were as toxic at the 5·5-inch depth as at the surface, but all other compounds and mixtures were most effective at the surface. Of the mixtures, acrylonitrile and carbon tetrachloride (1 : 1) was the most toxic and ethylene dichloride and carbon tetrachloride (3 : 1) the least.

There appeared to be no relation between toxicity to either species in the presence of wheat and the molecular weights and boiling-points of the compounds.

LINDGREN (D. L.) & SINCLAIR (W. B.). **Tolerance of *Citrus* and Avocado Fruits to Fumigants effective against the Oriental Fruit Fly.**—*J. econ. Ent.* **44** no. 6 pp. 980–990, 9 figs., 3 refs. Menasha, Wis., 1951.

The following is based on the authors' introduction and summary. Since the discovery of *Dacus ferrugineus dorsalis* Hend. in Hawaii [*cf. R.A.E.*, A **38** 316 ; **39** 175], plans have been made in California for the treatment of various commodities for control of the insect, should it spread to the mainland of the United States. One method of treating fruits is by fumigation, and investigations were therefore carried out to find a fumigant that could be used without injuring the fruits and without leaving harmful toxic residues.

Valencia and navel oranges, grapefruits, lemons and avocados were treated with various fumigants or mixtures at different dosages and for different periods of exposure at 80°F. in a gas-tight metal chamber with a capacity of 100 cu. ft. and subsequently stored, and the development of tissue injury and breakdown was recorded. The amount of a fumigant taken up by a commodity during fumigation depends on the character of the material being fumigated and the physical and chemical properties of the fumigant. Under the conditions of the experiments, ethylene dibromide was more highly adsorbed than methyl bromide on the exposed surfaces of the fumigation chamber and of the fruits being fumigated.

Fumigation injury to the fruits did not appear until 5–14 days after treatment, the rate of development depending on storage temperature, varietal tolerance, maturity of fruit, the district in which it was grown and the chemical properties and specific effects and dosage of the fumigant. Of the *Citrus* fruits, navel oranges were generally more susceptible to injury than the others, but none was injured by fumigation with ethylene dibromide, ethylene chlorobromide or methyl bromide at 1 lb. per 1,000 cu. ft. for two hours. At 2 lb. per 1,000 cu. ft. for two hours, ethylene dibromide caused severe injury and methyl bromide was sometimes injurious, depending on the condition of the fruits, and this dosage is therefore considered too high. The amount of bromine retained by *Citrus* fruits fumigated with methyl bromide was usually proportional to the dosage, but exceptions occurred. The thickness of the peel, dosage and exposure time were important factors affecting the amounts of bromine that diffused through the peel to the pulp.

Avocados were severely injured by fumigation with ethylene oxide, acrylonitrile and a mixture of the latter and carbon tetrachloride (1 : 1) at dosages of 1–5 lb. per 1,000 cu. ft. for two hours and were also susceptible to injury by methyl bromide at 2 lb. per 1,000 cu. ft. for four hours. They absorbed considerable amounts of bromine when fumigated with methyl bromide, and the edible portions of the fruit retained 70 per cent. of the total bromine absorbed at the end of seven days.

HOUGH (W. S.). **Control of Plum Curculio on Plums.**—*J. econ. Ent.* **44** no. 6 pp. 992–993, 4 refs. Menasha, Wis., 1951.

The results are given of further tests on the control of the plum curculio [*Conotrachelus nenuphar* (Hbst.)] on damson plums of the French type in Virginia [*cf. R.A.E.*, A **38** 71]. Dense ground cover favoured the survival of the adults from year to year, making control difficult, and both this and the trees themselves were sprayed. Control was estimated by examining samples of fruit picked in early June or a few days after injury by the first generation ceased. No evidence of further injury by the weevil was observed before harvest in July.

In 1949, a petal-fall spray of 1 lb. 25 per cent. wettable parathion followed by three weekly applications of the same spray begun 17 days later gave very

little control, and in 1950–51, 4–5 applications of this spray at approximately weekly intervals beginning at petal-fall were not adequate, but 5 applications of 2 lb. 25 per cent. parathion at intervals of 5–7 days resulted in more than 94 per cent. uninjured fruits in 1951. No spray injury to the trees was observed. It is reported that the trees sprayed with chlordan in 1948 [*loc. cit.*] did not recover.

EDEN (W. G.). **Control of the Vetch Bruchid in Alabama.**—*J. econ. Ent.* **44** no. 6 pp. 993–994, 4 refs. Menasha, Wis., 1951.

Bruchus brachialis Fhs. causes severe damage to vetch grown for seed in the Tennessee Valley area of Alabama, and experiments on its control were carried out in 1949-50. Since the Bruchid does not emerge from the seed in this district until after harvest, which is usually in June, the effect of fumigation of newly harvested seed was tested. Samples of infested seed were fumigated with 5 lb. of a mixture of acrylonitrile and carbon tetrachloride (1 : 1) per 1,000 cu. ft. for 24 hours, and this completely prevented insect emergence, but gave no improvement in percentage germination over untreated seed, indicating that viability had been destroyed before harvest. Control measures in the field were therefore tested.

One application of 35 lb. 5 per cent. DDT, 1 per cent. rotenone, 10 per cent. toxaphene or 5 per cent. chlordan per acre in 1949 when the pods were forming had no effect on the number of Bruchids emerging from the seed, but two in 1950 of 5 or 10 per cent. DDT, 10 per cent. chlordan or 2·5 per cent. aldrin [1,2,3,4,10,10 - hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4,5,8 - diendo - methanonaphthalene], on 5th May, when the vetch was beginning to bloom freely, and again on 17th May, all reduced the infestation significantly. Aldrin and 10 per cent. DDT were superior to 5 per cent. DDT, with chlordan intermediate in value. Two applications of 1 per cent. parathion were ineffective.

KNOWLTON (G. F.). **Boxelder Bug Damage to Crops.**—*J. econ. Ent.* **44** no. 6 p. 994. Menasha, Wis., 1951.

Leptocoris trivittatus (Say) has of recent years been observed feeding sporadically in large numbers on various fruits in orchards in Utah. Pear and peach fruits were heavily attacked in September 1948, and ripe apricots and apples had been injured earlier in the season. The flesh of the apples became brown and woody after a few days' feeding by the bugs, nearly all of which were adults. The bugs also congregated on apricot twigs. Similar infestations recurred in 1949, and were probably due to breeding on boxelder [*Acer negundo*] along ditches and in hedges. Berry fruits have also been injured, and the tops of potato plants were attacked at one place in August 1950. The bugs have also been found feeding on dead and dying honey bees [*R.A.E.*, A **37** 301, etc.], fallen fruits and potted house plants.

ANTHON (E. W.). **Sprays for the Fruit Tree Leaf Roller.**—*J. econ. Ent.* **44** no. 6 p. 995. Menasha, Wis., 1951.

Tortrix (*Archips*) *argyrospila* (Wlk.) caused severe damage to cherry leaves and fruits in north-central Washington in 1949 and 1950, and preliminary field experiments in 1949 indicated that parathion sprays gave very good control. In 1950, single applications of sprays containing 2 lb. 50 per cent. DDT, 1 lb. 25 per cent. lindane [at least 99 per cent. benzene hexachloride] or 0·5 lb. 25 per cent. parathion, all as wettable powders, or 8 fl. oz. 25 per cent. O-(2-chloro-4-nitrophenyl) O,O-dimethyl thiophosphate emulsion concentrate

per 100 U.S. gals. on 13th May (after sepal-fall) gave good control on the leaves of heavily infested cherry trees, and one of 2 lb. 50 per cent. DDT and 0·5 lb. 25 per cent. parathion per 100 U.S. gals. was fairly effective in spite of defective application. A spray of 3 lb. lead arsenate per 100 U.S. gals. gave some reduction but had to be repeated to obtain commercial control.

T. argyrospila has an extended hatching period and causes considerable damage to leaves and fruits before sepal-fall. It is considered that a spray of DDT and parathion, applied at the pre-bloom stage, would afford the best control, parathion giving immediate kill of the young larvae and DDT giving prolonged protection against late-hatching individuals. It would also kill the larvae before they web the leaves together.

FENTON (F. A.). **The Brown Wheat Mite** *Petrobia latens*.—*J. econ. Ent.* **44** no. 6 p. 996, 1 ref. Menasha, Wis., 1951.

Petrobia latens (Müller) [*cf. R.A.E.*, A **40** 72] causes considerable damage to wheat in the panhandle and most western counties of Oklahoma and has been collected as far east as Stillwater. It is injurious in dry weather and causes damage similar to that due to drought. Observations on its bionomics showed that the mite is parthenogenetic, and no males were found. Eggs of two types were laid, termed summer and winter eggs, respectively, 70–90 of the former or 30 of the latter being deposited over a period of about three weeks. No female laid eggs of both types. The summer eggs hatched in 6–7 days at 75°F. and 52 per cent. relative humidity and development to the adult lasted 8–9 days. All stages are briefly described. In tests on control [*cf. loc. cit.*], a spray of 0·05 per cent. TEPP (tetraethyl pyrophosphate) at 31–33 U.S. gals. per acre caused rapid mortality, but the populations increased again in a few days. Dusts of 0·5–2 per cent. parathion, applied at 42–53 lb. per acre, and a 0·05 per cent. parathion spray at 32 U.S. gals. per acre caused 79–83 and 65 per cent. reduction in population, respectively, in 27 hours. A dust of 97·5 per cent. sulphur at 38 lb. per acre was slow in action, but caused 76 per cent. reduction in eight days, which compared favourably with 46 per cent. for the best TEPP treatment and 50 per cent. for the best parathion treatment at that time. Rain fell 9–11 days after treatment and almost eliminated the infestation from all plots.

BYNUM (W. M.). **The Desert Damp-wood Termite in the Lower Rio Grande Valley of Texas.**—*J. econ. Ent.* **44** no. 6 pp. 996–997, 1 fig., 1 ref. Menasha, Wis., 1951.

Paraneotermes (*Kalotermes*) *simplicicornis* (Banks) has been found in destructive numbers in many young *Citrus* orchards in the Lower Rio Grande Valley of Texas. It severs the taproot and lateral roots of the trees in one or more places [*cf. R.A.E.*, A **26** 219], and the injured trees die suddenly, damage being probably complete before the leaves wither. Roots up to 2 ins. in diameter were found severed. The termites seemed to be most prevalent on recently cleared land, especially in the dry-land areas. Damage was extensive where the soil is sandy and light, especially on tank-truck watered orchards and in areas bounded by thickets of mesquite [*Prosopis juliflora*], hedgerows or railways.

RICHARDSON (C. H.) & DU CHANOIS (F. R.). **Organosilicon Compounds with DDT-like Structure as Contact Insecticides.**—*J. econ. Ent.* **44** no. 6 pp. 997–998, 2 refs. Menasha, Wis., 1951.

In tests with nine organosilicon compounds, several of which contained p-chlorophenyl or trichloromethyl groups attached to silicon and were similar

in structure to DDT, dusts of pure phenyl-tris(p-chlorophenyl)-silane killed 2 per cent. of adults of *Tribolium castaneum* (Hbst.) and 30 per cent. of adults of *Oncopeltus fasciatus* (Dall.) ; a 10 per cent. dust also killed 2 per cent. of *Tribolium*. (Trichloromethyl)-tris(p-chlorophenyl)-silane killed 2 per cent. of the beetles at 50 per cent. but was ineffective at 10 and 100 per cent. and the liquids tetra-n-butylsilane and methyl-(dichloromethyl)-bis(p-chlorophenyl)-silane, applied to them topically, killed them almost immediately and a little more slowly, respectively. The other materials were ineffective, and it is concluded that such silicon compounds are either inert or very mildly toxic to the insects used.

WALTER (E. V.) & WENE (G. P.). **Tests of Insecticides to control Larvae of *Euxesta stigmatias* and *Megaselia scalaris*.**—*J. econ. Ent.* **44** no. 6 pp. 998–999, 2 refs. Menasha, Wis., 1951.

Euxesta stigmatias Lw., which is widely distributed in tropical America but had been recorded in the United States only from southern Florida [*R.A.E.*, A **28** 483], was found in 1942 in the ears of green maize in the Lower Rio Grande Valley of Texas and increased until nearly all the ears of unprotected late maize were attacked in 1950. *Megaselia scalaris* (Lw.), a Phorid that is generally considered to be a scavenger, was also found feeding in the ears in 1944 and increased likewise. Eggs of both species are deposited on the silks just beneath the tip of the husk, and larvae of *M. scalaris* feed between and at the base of the kernels and among the bracts on the cob, penetrating deeper than those of *E. stigmatias*. The two insects were so abundant in 1950 that after about 20th May, scarcely any saleable maize could be harvested from many fields. Fields that had been sprayed two or three times with an oil emulsion containing DDT for the control of the corn earworm [*Heliothis armigera* (Hb.)] were only lightly infested, but those in which the ears were treated by hand with DDT in mineral oil had a much higher infestation, indicating that spraying had killed many of the adults before oviposition and that the insecticidal deposit on the leaves may have killed others later.

In laboratory tests in which larvae of *E. stigmatias* were thoroughly wetted with spray and allowed to crawl on spray residues and mortality after 48 hours was calculated by Abbott's formula [**13** 331], a highly refined white mineral oil (viscosity 95 secs. Saybolt at 100°F.) caused 50 per cent. mortality when used alone and 58 per cent. with the addition of 1 per cent. DDT, whereas 1 per cent. DDT in 10 and 25 per cent. oil emulsion and in water gave 9, 5 and 4 per cent., respectively. Emulsion sprays of 0·25–1 per cent. DDT, heptachlor [1 (or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene], aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], toxaphene or a mixture of parathion and its methyl homologue (1 : 4) gave low mortality of both *Euxesta* and *Megaselia*, with the parathion mixture at 1 per cent. the most effective (57 and 42 per cent. mortality), 1 per cent. tetraethyl pyrophosphate and 0·01 per cent. pyrethrins were weakly toxic to *Euxesta*, and 1 per cent. of a mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane (1 : 2) gave 62 per cent. mortality of *Megaselia*. Five adults of *E. stigmatias* that were introduced into a jar containing 5 per cent. chlordan dust were dead within an hour. It is concluded that the larvae of both insects are resistant to insecticides that might commonly be used against *H. armigera*, but that satisfactory control might be achieved by killing the adults before they oviposit.

App's record of *E. stigmatias* from maize in Porto Rico [**27** 328] is considered doubtful, since the accompanying figure showed a typical larva of *M. scalaris*.

CALLENBACH (J. A.). **Rescue Wheat and its Resistance to Wheat Stem Sawfly Attack.**—*J. econ. Ent.* **44** no. 6 pp. 999–1001. Menasha, Wis., 1951.

In view of reports in Montana that Rescue wheat [*cf. R.A.E.*, A **37** 233] is losing its resistance to the wheat stem sawfly [*Cephus cinctus* Nort.] or that strains of the sawfly able to maintain themselves in it are developing, field-plot experiments, the technique of which is described, were begun in the spring of 1949 to determine whether sawfly strains were segregating from the general population and to find the distribution and amount of solidness in the stems, as a possible explanation for the variability in sawfly resistance. The following is based on the author's summary of the results.

The existence of sawfly races that could successfully attack Rescue wheat could not be demonstrated. Examination of cut stems showed considerable variability in tunnelling, 1·5 per cent. of the larvae being confined to one internode and 17·2 per cent. to two, and 81·3 per cent. tunnelling in three or more. Examination of uncut stems showed considerable variation in distribution of solidness within the stem, and 19 categories were recorded. About 11 per cent. of the stems having 4–5 internodes were hollow in the second internode from the base ; this figure closely approximates the recorded cutting average of 12·4 per cent. When large samples are selected, the second internode may be useful as an index of resistance, but in small samples, the observed variability makes its value doubtful.

KECK (C. B.). **Effect of Temperature on Development and Activity of the Melon Fly.**—*J. econ. Ent.* **44** no. 6 pp. 1001–1002. Menasha, Wis., 1951.

The results are given of investigations in Hawaii on the effect of temperature on the activity of adults of *Dacus cucurbitae* Coq. and the rate of development of the various stages. Most tests were made at temperatures ranging from 55° to 100°F. by intervals of 5°. The preoviposition period ranged from 26–48 days at 60 to 7–20 at 90°, being practically unchanged between 80 and 90°, and was 11–31 days at 95°. No eggs were deposited at 55° and no flies lived long enough to oviposit at 100°. Males became sexually mature as soon as females. Adults feed immediately after emergence and die in 1–2 days if deprived of food and water at the higher temperatures, but live a week or more without food at 55–65° and for several weeks if they obtain food at intervals of 3–4 days. The greatest number of eggs deposited by any one female was 1,813 during a life of 150 days at 80°. The average numbers deposited per day during the first 30 days of oviposition varied from 2·9–9·1 at 60° to 9·1–27·2 at 90 and were 6·7–19·9 at 95°. In general, a third of the eggs are laid during the first 30 days of oviposition. The egg stage decreased from 50–58 hours at 65° to 17–24 at 90° and was 18–23 at 95°. No eggs hatched at 100° and only a few at 55°. The larval stage in tomatos varied from 11–15 days at 60° to 4–8 days at 80° and did not vary much between 80 and 95°. At 100°, very few larvae were reared to the puparial stage and no adults emerged. The shortest time spent in the puparium was seven days at 85–95°. No adults emerged from puparia kept at 100°F.

MEDLER (J. T.) & BARROW (M.). **Performance of Gear Pumps with Wettable Powder and Emulsion Sprays.**—*J. econ. Ent.* **44** no. 6 pp. 1003–1004, 2 graphs, 1 ref. Menasha, Wis., 1951.

Low-volume sprayers are generally used to apply the newer insecticides for the control of insects on lucerne grown for seed in Wisconsin [*cf. R.A.E.*, A **38** 196], and the rotary gear pump is probably the one most commonly incorporated in them. To determine the extent to which wettable powders abrade such pumps, 120,570 U.S. gals. of a clay suspension and 147,816 U.S.

gals. of xylene emulsion were pumped through two bronze gear pumps in 100 hours. Losses in volume delivery of 16 and 4·5 per cent., respectively, were recorded at the end of the tests, and it is concluded that an emulsion causes less loss in effectiveness than a clay suspension. Repacking the seal did not give an appreciable increase in effectiveness after 100 hours of use.

STANLEY (W. W.). **Experiments to control the Woolly Apple Aphis on Nursery Stock.**—*J. econ. Ent.* **44** no. 6 pp. 1006–1007, 1 ref. Menasha, Wis., 1951.

In tests on the control of woolly apple aphis [*Eriosoma lanigerum* (Hsm.)] on apple stock in nurseries, begun in Tennessee in April 1949, insecticidal dusts were applied in furrows containing fertiliser, which were covered and slightly hilled, and calloused grafts were set in these and allowed to grow with no further attempts at control and a minimum of cultivation for two seasons. Examination at the end of this time showed that treatment with 2–8 lb. γ BHC (benzene hexachloride) or 6–8 lb. chlordan per acre resulted in more than 90 per cent. uninfested and uninjured trees, 2–4 lb. aldrin [1,2,3,4,10,10-hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4,5,8 - diendomethanonaphthalene] in about 83–86 per cent. and 2–8 lb. parathion in 72–74 per cent. ; there were 59 per cent. in untreated soil. No injurious effects from the insecticides were observed.

In 1950, uninfested trees one year old were given three applications of insecticide at fortnightly intervals from 24th April, at about the period when migration from elms [*Ulmus americana*] takes place [*cf. R.A.E.*, A **24** 10], the materials being applied in 600 U.S. gals. water per acre to the bases of the trees over a strip about 12–15 ins. wide. On 24th May, when several aerial colonies of the Aphid were present, all plants were sprayed with 0·03 per cent. γ BHC, but no other attempt at control was made. Examination of the trees on 10th January 1951 showed that more than 90 per cent. of those treated with emulsion concentrates to give 1–2 lb. γ BHC or 2·5–5 lb. chlordan or with wettable powders to give 8 lb. lindane [at least 99 per cent. γ BHC], 5 lb. chlordan or 1 lb. aldrin per acre were uninfested, as compared with 87 per cent. for 1 per cent. dichloroethyl ether and 61 per cent. for no treatment. None of the insecticides caused plant injury.

GERBERG (E. J.). **Control of *Anthrenus vorax* on Hog Bristles.**—*J. econ. Ent.* **44** no. 6 pp. 1007–1008. Menasha, Wis., 1951.

Larvae of *Anthrenus vorax* Waterh. caused considerable damage to hog bristles used for manufacturing paint brushes in 1949, and attempts were made in Baltimore to find an insecticide that could be applied economically in normal production to give prolonged protection without affecting the quality of the product. During manufacture of the brushes, the bristles are subjected to heat and chemical treatments that would kill any stage of the insect ; the final treatment is a dip in an organic solvent, and technical chlordan was added to this at concentrations of 0·25–4 per cent. by weight. Larvae of various instars confined in jars with brushes that had been treated 24 hours previously were knocked down in 24 hours and died within 14 days. All larvae confined with brushes treated 30 or 60 days previously were knocked down in seven days, and all those on brushes treated with 1–4 per cent. chlordan and most of those on the others died in 30 days. Practically all larvae introduced four months after treatment were knocked down or killed in 30 days, and all those introduced after 7 and 12 months died in 45 and 72 days, respectively. The 4 per cent. solution was still giving 90 per cent. knockdown in seven days 12 months after use, and it is concluded that treatment with a solution of chlordan will protect brushes from serious injury for a year or more.

ANDERSON (L. D.) & GUNTHER (F. A.). **Sampling Techniques for Determination of DDT Residue on Sweet Corn.**—*J. econ. Ent.* **44** no. 6 pp. 1008–1010, 6 refs. Menasha, Wis., 1951.

Investigations in California in 1948–49 on the residues on sweet maize treated with DDT against the corn earworm [*Heliothis armigera* (Hb.)] showed that the edible part of the ears rarely had more than 1 part per million DDT, whatever the rate or method of application, but residues on the husks and silks showed wide variation, and attempts were made in 1950 to evolve a satisfactory sampling method.

Dusts of 5 per cent. DDT were applied to individual ears with a paint brush [*cf. R.A.E.*, A **40** 112] at 30–40 lb. per acre per application on 27th and 30th June and 3rd July, and samples of 5, 10, 20 or 40 ears were selected at random from ears of average size on 19th July, put in paper bags and stored in a refrigerator overnight. On the following day, the husks were removed, finely ground and mixed, and the ears sliced and mixed, 1 lb. samples were extracted with benzene, and the DDT residues in evaporated aliquots of the extracts were determined [*cf.* **35** 412]. Statistical analyses of variance showed no significant differences in apparent DDT residue between samples within a class. Average amounts of 0·99–1·4 p.p.m. DDT were found on kernels and cobs, and the high percentage coefficient of variation for these samples indicated that the residue differences between them were of little significance, ten replicates of five ears affording data as significant as 20 replicates of 40 ears. The average DDT residues on treated samples of husks and silks were 229–283 p.p.m. The coefficients of variation were 23–16 per cent. for samples of 5–40 ears replicated ten times and 25–11 for the same samples replicated 20 times, indicating that increasing the size of the samples from 5 to 40 ears gave little advantage with ten replications though it caused a more considerable decrease in variability with 20. If 25 per cent. variation is reliable enough for a comparison, a five-ear sample replicated ten times will be the most practical. Approximately 1 and 1·7 p.p.m. average apparent DDT residues were found on untreated samples of kernels and cobs and of husks and silks, respectively.

BARKER (J. S.) & TAUBER (O. E.). **Fecundity of and Plant Injury by the Pea Aphid as influenced by nutritional Changes in the Garden Pea.**—*J. econ. Ent.* **44** no. 6 pp. 1010–1012, 1 ref. Menasha, Wis., 1951.

In further investigations on the effect on Aphids of nutritional changes in their food-plants [*cf. R.A.E.*, A **39** 277], sterilised seeds of garden pea were sown in sterile sand and watered with nutrient solutions deficient in nitrogen, phosphorus, potassium, calcium or magnesium until symptoms of nutrient deficiency appeared, after which a small amount of the missing element was added to keep the plants thrifty enough to support the Aphid, *Macrosiphum pisum* (Harris) (*pisi* (Kalt.)). This usually occurred when the plants were three weeks old, and females in the first instar were then transferred to the plants. These were reduced to ten per plant on the day before they matured, and the young were counted and removed at intervals of 1–4 days till the death of the females. The experiment was repeated with plants four weeks old to observe the effect of increased severity of deficiency on the insects, and observations were made on the reaction of the plants to Aphid feeding in both tests.

Reduction in fecundity was significant on all plants deficient in nutrients. It was most pronounced for nitrogen and phosphorus deficiencies, less for calcium and magnesium and apparent only at four weeks for potassium. It was significantly greater on four-week plants than on three-week plants, in spite of some reduction on plants receiving full nutrients. The plants subjected

to deficiency succumbed to Aphid feeding earlier than those receiving full nutrients, and this was more evident at four weeks than at three. Plants deficient in nitrogen and phosphorus had the shortest life after infestation began. This increased injury of deficient plants and an associated decrease in the survival period of the Aphids on them are considered to be largely responsible for the reduction in fecundity. Any direct nutritional effect on *M. pisum* is believed to have been of secondary importance.

The results suggest that garden peas grown on soils severely deficient in any of the elements studied would be more injured by *M. pisum* than plants grown on soils of good fertility, being less tolerant of the feeding injury, although at the time when the plants were being most severely injured, the reproductive ability of the Aphid would be reduced.

ANTHON (E. W.). **New Insecticides, including systemic Insecticides, for Control of Black Cherry Aphids.**—*J. econ. Ent.* **44** no. 6 p. 1012. Menasha, Wis., 1951.

In preliminary laboratory and greenhouse experiments in Washington, watering or spraying peach seedlings with low concentrations of the systemic materials, schradan (octamethyl pyrophosphoramide), trialkyl thiophosphate (as a 32·1 per cent. emulsion concentrate [Systox, containing 32·1 per cent. diethyl ethylmercaptoethyl thiophosphate]) and a selenium analogue of the latter (as a 30·6 per cent. emulsion concentrate), controlled *Myzus persicae* (Sulz.) and *Tetranychus bimaculatus* Harvey. In field tests, sprays of 0·8 pint 45·7 per cent. schradan per 100 gals. were applied with a hand sprayer to branches of cherry trees for the control of *M. cerasi* (F.). When only the bases of the infested terminals were sprayed, a few Aphids remained alive after four days on two of ten replicates, but none after nine days. When the entire branch was sprayed, no living Aphids were found 4–9 days after treatment.

In further tests in 1950 in which the insecticides were applied to entire cherry trees heavily infested by *M. cerasi*, sprays of 1 lb. 25 per cent. S-(1,2-dicarbethoxyethyl) O,O-dimethyl dithiophosphate or 8 oz. 25 per cent. parathion as wettable powders, 8 fl. oz. 25 per cent. O-(2-chloro-4-nitrophenyl) O,O-dimethyl thiophosphate or 1 U.S. pint 47·7 per cent. S-(1,2-dicarbethoxyethyl) O,O-dimethyl dithiophosphate as emulsion concentrates, 8 fl. oz. Metacide (an emulsion concentrate containing 6·2 per cent. parathion, 24·5 per cent. methyl-parathion and 2·7 per cent. related phosphates) or 4 fl. oz. of the concentrates of trialkyl thiophosphate or the selenium analogue, all per 100 U.S. gals., on 8th July gave more than 97 per cent. mortality in 48 hours, the last three giving complete control. Mortality on untreated trees was 7 per cent.

EDEN (W. G.). **Toxicity of Dieldrin to Chickens.**—*J. econ. Ent.* **44** no. 6 p. 1013, 2 refs. Menasha, Wis., 1951.

The effects of acute and chronic oral doses of dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] on chicks three and six weeks old were investigated in 1950. Single doses ranging from 5 to 35 mg. per kg. body weight for the younger group and from 10 to 40 mg. per kg. for the older ones were administered in capsules, each to 6–10 birds. The percentage mortality caused by each dose is shown in a table. The dosage giving 50 per cent. mortality was found to be between 20 and 30 mg. per kg. for both groups. In the test on chronic toxicity, 14 chicks of each age group were given 25, 50 and 100 parts dieldrin per million in mash and the experiment was continued for 90 days. All those receiving the two larger dosages died before the end of this period, length of survival being inversely proportional to the amount of dieldrin in the diet. The birds receiving 25 p.p.m. ate

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Reduction in fecundity was significant on all plants deficient in nutrients. It was most pronounced for nitrogen and phosphorus deficiencies, less for calcium and magnesium and apparent only at four weeks for potassium. It was significantly greater on four-week plants than on three-week plants, in spite of some reduction on plants receiving full nutrients. The plants subjected

1·3 gm. in 20,000 cu. ft. per 24 hours gave almost complete control of *T. bisselliella* in a rug on a pad of fibre and pig hair in a church, but a few moths were observed beneath it after treatment for eight weeks.

GOUCK (H. K.) & BLANCHARD (R. A.). **Effects of some organic Compounds and Mineral Oil on Corn Earworm Eggs.**—*J. econ. Ent.* **44** no. 6 p. 1018, 4 refs. Menasha, Wis., 1951.

The results are given of tests in Illinois of emulsions containing 0·5 per cent. 2-phenoxyethyl chloroacetate, ethyl α,β-dibromopropionate, 1,4-dichloro-2-nitrobenzene, N-butylacetanilide, cyclopentanepropionic acid or cyclohexanepropionic acid, alone and with 7·5 per cent. mineral oil (viscosity 80–90 secs. Saybolt), against the eggs of *Heliothis armigera* (Hb.). The first two compounds were first dissolved in acetone and the others in xylene, and a mixture of polyoxyethylene ester and alkylaryl sulphonate was used as emulsifier. The solvents were used at 0·3 per cent. except with the nitrobenzene, for which 0·8 per cent. was used. The emulsions were applied once in the autumn of 1950 with a hand sprayer to the silks of sweet-maize ears naturally infested with 7–15 eggs per ear, and the silks with eggs were removed from the ears about nine hours later and the eggs kept in vials for observation ; the larvae were removed as they hatched.

Emulsions containing the propionic acids and the propionate without oil killed 25–47 per cent. of the eggs, whereas those containing the other three compounds without oil and xylene alone showed little toxicity. All materials with oil killed 57–95 per cent. and an emulsion of xylene alone with oil was as good as any other tested, indicating that the oil itself was a better ovicide than the organic compounds. The mineral oil in the sprays normally used against *H. armigera* probably acts both as a penetrant and as an ovicide.

SHIRCK (F. H.). **Hibernation of Onion Thrips in southern Idaho.**—*J. econ. Ent.* **44** no. 6 pp. 1020-1021, 1 graph, 1 ref. Menasha, Wis., 1951.

Investigations were carried out in 1945–50 in southern Idaho to find where and in what stage *Thrips tabaci* Lind. overwinters and the effect of overwintered populations on the severity of the outbreak on onions in the growing season. Samples were taken by methods described from lucerne, red clover, grass sod and onion at fortnightly intervals throughout the winter. The results showed that the thrips hibernated principally in the crowns of the plants ; samples consisting of a thin layer of soil from below the plants or of trash or surface soil in onion fields from which the bulbs had been harvested and removed contained none. Grass sod, even round the margins of old onion fields, contained very few examples, and because of the small area of standing onions available in winter, it is considered that this crop is of little importance to overwintering thrips. Larval populations decreased on clover and lucerne until December and March, respectively, the thrips overwintering principally as adults on these two crops, and the first significant increases in larvae and adults occurred in April and May, respectively. Onions are planted in April and gradually become infested in June by the migration of adults from clover, lucerne and other sources, but infestation does not become serious until the mean daily temperatures reach 70°F. The results indicated that thrips outbreaks on onion bore little direct relation to the size of the overwintering populations on lucerne and clover.

JEFFERSON (R. N.). **Octamethyl Pyrophosphoramide and a Trialkyl Thiophosphate for Control of Aphids on** *Centaurea cyanus.*—*J. econ. Ent.* **44** no. 6 pp. 1021–1022, 1 ref. Menasha, Wis., 1951.

Schradan (octamethyl pyrophosphoramide) and Systox (an emulsion concentrate containing 32·1 per cent. diethyl ethylmercaptoethyl thiophosphate) were tested for the control of *Anuraphis padi* (L.) (*Aphis helichrysi* Kalt.) on *Centaurea cyanus* in California in 1951. The Aphid is difficult to reach on this plant with ordinary sprays, and it was thought that the systemic insecticides might prove more effective. Schradan was used at 2 U.S. quarts 47 per cent. emulsion concentrate (2 lb. actual compound) and Systox at 1 U.S. pint (0·375 lb. actual compound) per 100 U.S. gals. and applied with a hand sprayer on 21st May, when the plants were 4–8 ins. high, and with a power sprayer on 15th June. The percentages of buds infested on the schradan and Systox plots were 13 and 15·5 (as compared with 72 for no treatment) on 15th June, 4·5 and 16·9 on 13th July and 4·5 and 7 on 25th July, and the percentages of plants showing Aphid injury on 13th July were 1·1 and 1·2, respectively, as compared with 82 for no treatment, damage to treated plants being apparent only on close examination and that on untreated ones very severe.

In order to compare the two materials on maturing plants, a third application was made to one schradan plot and one Systox plot on 13th July, and each material was also applied to half an untreated plot. The third applications did not significantly reduce the percentages of buds infested on 25th July, but examination on the same date showed 40 per cent. infestation on the plants receiving one application of schradan, as compared with 100 for no treatment, and 4 per cent. on those receiving one application of Systox, as compared with 96. The comparative ineffectiveness of schradan may have been due to poor absorption by the plants, and the superiority of the thiophosphate to its contact or fumigant effect on the exposed Aphids. Schradan has little contact action and no fumigant effect [*cf.* *R.A.E.*, A **38** 192].

DENNIS (N. M.). **Effect on Fumigation of adding Sulfur Dioxide to a Carbon Tetrachloride-Carbon Disulphide Mixture.**—*J. econ. Ent.* **44** no. 6 pp. 1022–1023, 2 refs. Menasha, Wis., 1951.

Small quantities of sulphur dioxide are sometimes added to the mixture of carbon tetrachloride and carbon bisulphide used as a grain fumigant, and laboratory experiments were therefore carried out to compare mixtures of carbon tetrachloride and carbon bisulphide (80 : 20) and of these materials and sulphur dioxide (78 : 20 : 2) against *Calandra* (*Sitophilus*) *oryzae* (L.) and *Tribolium confusum* Duv. in empty and wheat-filled containers. The fumigants were applied to the surface of wheat in which insects or infested wheat in bags were buried or, in the absence of wheat, by reducing the pressure in the vessels in which the bags were suspended and using the partial vacuum to draw in the fumigant. The wheat contained 11·5 per cent. moisture, and the exposure was for 20 hours at 70°F.

In vessels containing no wheat, the minimum lethal doses for complete mortality of adults and immature stages of *Calandra* and adults and eggs of *Tribolium* were 76, 764, 61 and 182 mg. of the first mixture and 23, 153, 53 and 153 of the second per litre, and in those containing wheat, the minimum lethal dosages for adults and immature stages of *Calandra* and adults of *Tribolium* were 178, 1,529 and 166 mg. of the first mixture and 153, 1,221 and 153 of the second per litre. The addition of sulphur dioxide thus increased the toxicity of the mixture to both species.

The dosages necessary to kill all adults of *Calandra* in wheat corresponded to 1·1 U.S. gals. of the first mixture and 0·9 of the second per 1,000 bushels of

grain, and those necessary to kill all the immature stages to 9·3 and 7·5 U.S. gals. per 1,000 bushels, respectively, but it is not necessary to use such large dosages in practice, as the post-fumigation effect of the materials retained by the treated grain results in much higher mortality than is obtained in an exposure of only 20 hours.

SNOW (S. J.) & MCCLELLAN (S.). *Tortrix pallorana*, **a Pest of Seed Alfalfa in Utah.**—*J. econ. Ent.* **44** no. 6 pp. 1023–1024, 5 refs. Menasha, Wis., 1951.

Tortrix pallorana Rob. damaged seed lucerne over limited areas in Utah in 1948–50 by tying the racemes of the flowers together and so preventing pollination. Actual feeding on the leaves and flowers was unimportant. In observations on the seasonal history of the insect in 1950, overwintered larvae were found feeding within webbed leaves in May and June. Adults appeared on 19th June and were numerous in the first half of July. Fresh egg-masses were found from 28th June to 11th July, and hatching was first recorded on 10th July. The larvae dispersed rapidly and were numerous enough to cause light injury to some plants from mid-July to mid-August. Pupation occurred chiefly in August within several leaves or racemes webbed together, and adults of this generation were present from 14th August to 27th September. The first eggs of the second generation were found on 28th August, and newly hatched larvae on 11th September. Immature larvae were found in the short autumn growth in early October, after the seed crop was harvested.

Applications of emulsion sprays of DDT to second-crop seed lucerne in bud and of toxaphene to first-crop seed lucerne in bloom, each at 2 lb. per acre in 7·5 U.S. gals. water, gave little control. Sprays of toxaphene at 3 lb. per acre on 27th July and of 1·5 lb. chlordan, 0·4 lb. lindane [at least 99 per cent. γ benzene hexachloride), 0·5 lb. DDT, 3 or 6 lb. toxaphene or 0·4 lb. tetraethyl pyrophosphate per acre on 31st July gave no appreciable kill. After the seed crop was harvested, spraying the green autumn growth on 3rd October, when it was 2–3 ins. tall, with 2 lb. chlordan or 0·5 lb. dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] per acre gave no apparent kill.

BEARD (R. L.). **The Susceptibility of Maize to the Corn Leaf Aphid.**—*J. econ. Ent.* **44** no. 6 pp. 1024–1025, 3 refs. Menasha, Wis., 1951.

Maize plants that grow vegetatively without forming any tassels or ear shoots appeared in Connecticut in segregating rows of the C31 inbred and have been designated as due to the *id* factor, which is a monogenic mendelian recessive. These plants have been found to be peculiarly susceptible to attack by *Aphis maidis* Fitch. The whorls become heavily infested, and the preference of the Aphid is so definite that when normal C31 plants and C31 *id* plants are in comparable whorl stages, its presence is a reliable index of the plants carrying the *id* gene.

During 1951, plants of the inbred Oh26 were sprayed in the late whorl stage with maleic hydrazide in the form of the diethanolamine salt to retard growth. The results of this varied from almost complete retardation to no discernible effect with tassel sterility intermediate, depending on the exact growth stage at the time of treatment. In retarded plants, the whorl did not expand and no tassels or ear shoots appeared, but a heavy infestation by *A. maidis* developed within the whorl. The Aphid became established on no other plants of the same or different inbreds except on C31 *id* plants, which the retarded plants resembled, and the population persisted on both these until late in the season.

Although it is doubtful if there is a genetic factor for susceptibility or resistance to Aphids, there are certainly gene-controlled conditions that favour Aphid attack, establishment and rapid increase as manifested in the C31 *id* plants, and to this extent the retarded Oh26 plants represent a phenocopy of the C31 *id* plants. It was obvious that neither the whorl condition nor treatment with maleic hydrazide was directly responsible for Aphid infestation. At present, the susceptibility of the two types of plants offers no explanation of Aphid susceptibility in maize, but the results suggest means that can be used in the study of the factors involved in the food preferences of *A. maidis* and the conditions favouring its population increase.

KEISER (I.) & HENDERSON (C. F.). **A Method for determining Insecticide Residues per Unit of Leaf Surface.**—*J. econ. Ent.* **44** no. 6 pp. 1026–1027, 1 ref. Menasha, Wis., 1951.

The authors describe a rapid and accurate method for determining insecticide residue per unit area (square inch) of leaf surface. Several leaves of the plant concerned are dried and flattened, weighed and put on sheets of Ozalid paper so that the entire leaf surfaces can be photographed. The silhouetted pictures of the leaves are cut out, these and several whole sheets of the paper are weighed, and from these various weights and the known area of the paper, the weight per square inch of paper and thence the area and dry weight per square inch of the leaves can be calculated. Leaves bearing insecticidal deposit are dried and weighed, the amount of deposit is determined by chemical analysis, and the weight of deposit per square inch of leaf is calculated from the total weights of deposit and dried leaves and the weight per square inch of the leaves.

COTTON (R. T.). **Insect Pests of stored Grain and Grain Products. Identification, Habits and Methods of Control.**—Revd. edn., $8\frac{1}{2} \times 5\frac{1}{2}$ ins., [1+] i+244 pp., 93 figs., many refs., multigraph. Minneapolis, Minn., Burgess Publ. Co., 1950 (reprinted 1952). Price $3.25.

This edition of a book on the pests of stored grain and cereal products in the United States differs little from the previous one [*R.A.E.*, A **29** 605], but one or two additional pests are included, short descriptions of the type of damage caused by grain insects and of the ecological requirements of the more important species are added, and the information on preventive and control measures is brought up to date.

[NIKOL'SKAYA (M. N.).] **Никольская (M. Н.). On two Species of the Genus *Anagyrus* How. (Hymenoptera, Chalcidoidea), Parasites of the Comstock Mealybug.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **70** no. 3 pp. 545–547, 2 figs., 2 refs. Moscow, 1950.

The characters of both sexes of the genus *Anagyrus* are described, and a key is given differentiating *A. bohemani* (Westw.) and *A. diversicornis* Merc., two species that have been found in Soviet Central Asia among parasites of *Pseudococcus comstocki* (Kuw.), with notes on their synonymy, based on comparison of Russian material with descriptions published in the literature. It is concluded that *Philoponectroma opacum* Merc. is the male of *A. diversicornis*, that *A. kivuensis* Comp. is probably a synonym of *A. bohemani*, and that females of a parasite of *Pseudococcus* spp. in Palestine described as *Anagyrus* sp. by Rivnay & Perzelan [*R.A.E.*, A **32** 86] are definitely *A. bohemani* whereas the males belong to some other genus.

[Bondarenko (N. V.).] **Бондаренко (Н. В.). The Influence of shortened Day on the annual Cycle of Development of the common Spider Mite.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **70** no. 6 pp. 1077–1080, 13 refs. Moscow, 1950.

Tetranychus telarius (L.) (*urticae* Koch) produces numerous generations in summer in the Soviet Union and hibernates as the adult female. Before overwintering, the females cease to feed or reproduce and turn a reddish colour, and this occurs before the onset of autumn frosts and while food for the mites is still plentiful. In order to elucidate the cause of this behaviour, observations were made in the summer and autumn of 1948 in a greenhouse near Leningrad in which the mite was present on cucumber. The greenhouse was heated from 6th September.

Counts made every ten days for about 50 days from 16th June on a sample plant of the summer crop and from 27th August on one of the autumn crop showed that whereas the summer population was nearly 50 times as great at the end of the period as at the beginning, the rate of increase on the autumn crop was negligible and the population decreased.

Since this was not due to unfavourable conditions of temperature, relative humidity or food, experiments were begun in the summer of 1949 on the effect of changes in the length of the daylight period. In the first, cucumber plants bearing eggs of the mite were kept in a dark room and transferred to daylight for 4 or 8 hours each day. The controls were kept in natural daylight, and the difference in temperature was negligible. The mites in the experimental series developed normally until the adult stage, when the fertilised females ceased feeding after about a day, changed colour and did not oviposit. Exposure for 40 days to natural daylight conditions induced no change in them. The females that developed on the control plants fed and oviposited normally. When exposure to an 8-hour day was begun in each of the successive developmental stages of the mite, females of the overwintering type developed in all lots except those exposed in the adult stage only. Females of the winter type were considerably more resistant to cold than the summer ones, and when exposed to a temperature of −19°C. [−2·2°F.] 6 per cent. of the former were still alive after 18 hours, whereas 84 per cent. of the latter died in an hour and all in three hours.

Further tests showed that the critical daily exposure to daylight for the production of winter forms lay between 14 and 18 hours, only winter forms developing at the former and only summer ones at the latter. The change to the winter form apparently began at 16 hours 40 minutes. It is concluded that to bring about a state of hibernation in the mite, it would be sufficient to reduce the daily period of daylight to 12–14 hours from the time when the mites are in the last nymphal instar, and it is suggested that this method, which in itself increases the yield of cucumbers, could be used to check the activity of the mite in greenhouses.

[Peredel'skiĭ (A. A.).] **Передельский (А. А.). Changes in the Gluten of Wheat injured by different Species of Cereal Bugs.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N. S.) **71** no. 2 pp. 383–386, 3 refs. Moscow, 1950.

Pentatomids of several genera, including *Eurygaster*, *Aelia*, *Carpocoris* and *Palomena*, injure cereal crops in the Soviet Union by puncturing the grains, and some of them reduce the quality of the flour [*cf. R.A.E.*, A **40** 56, etc.]. Since the amount of damage caused by each species was not known, experiments were carried out in the Province of Moscow in 1949 in which four Pentatomids were released separately in varying numbers between the third week of July and at intervals up to ten days before harvest (late August) in cages

placed over spring wheat, and the resulting damage to the grains estimated. A cage in which no insects were liberated served as the control. The results, which are given in a table, showed that the percentages of grains punctured and (in brackets) the corresponding percentage yields of gluten were 9 (24) for *Carpocoris pudicus fuscispinus* (Boh.), 11–14 (29–32·7) for *Eurygaster maura* (L.) (*testudinaria* (Geoffr.)), 8–9 (31·3–34) for *Aelia acuminata* (L.), and 1·5–2 (36·5–38·5) for *Palomena prasina* (L.), as compared with 0·1–0·2 (39·3–39·9) for the control. Deterioration of the gluten, as shown by the increase in its ductibility, was slight for *A. acuminata*, but much more serious for *P. prasina*, *E. maura* and *C.p. fuscispinus*, in that order. A subsequent laboratory test showed that these results were not in any way due to the use of caged plants.

[Khristov (A.).] **Христов (А.). Plum narrow-striped Variegation.** [*In Bulgarian.*]—*Bull. Un. Travaill. sci. Bulg.* (Sér. Biol.) **5** no. 1 pp. 15–37, 3 pls., 6 refs. Sofia, 1949. (With Summaries in Russian and English.)

Narrow-striped variegation is a virus disease that has been observed in plum in several districts in Bulgaria since 1935. The symptoms appear as narrow pale or yellowish-green lines and rings on the leaves in spring, and though fruits are produced normally, they contain more acid and less sugar than usual and are sometimes marked by small sunken rings and spots. In experiments, the virus was transmitted by budding to peach, almond, cherry plum (*Prunus cerasifera*) and Japanese plum (*P. salicina*), but not to several other species of *Prunus* (including apricot and cherry) or to apple, pear or quince. It was also transmitted from diseased to healthy trees (mostly plum) by *Anuraphis padi* (L.) (*Brachycaudus helichrysi* (Kalt.)), but not by Aphids of four other species, including *Myzus* (*Myzodes*) *persicae* (Sulz.), or by *Typhlocyba rosae* (L.) or *Tetranychus telarius* (L.). The symptoms in the various experimental host plants and the properties of the virus are described. The incubation period lasted 8½–13½ months.

Papers noticed by Title only.

Common Names of British Insect and other Pests. Part two. Lice : Thrips : Plant Bugs, Aphids and Scale Insects : Butterflies and Moths : Fleas : Mites and Ticks.—40 pp. Association of Applied Biologists, 1952. Price 3*s*. (Copies obtainable from Miss B. M. Stokes, Rothamsted Experimental Station, Harpenden, Herts.) [*Cf. R.A.E.*, A **35** 194.]

Vappula (N. A.). **Finnish Entomological Literature published in 1949 including** [titles of papers on] **Economic Entomology and Control of Insect Pests.**—*Ann. ent. fenn.* **17** appx. 17 pp. Helsinki, 1951. [*Cf. R.A.E.*, A **39** 188.]

Enser (K.). **Histologische Untersuchungen über den Saugstich von *Aspidiotus perniciosus* Comst. (San José-Schildlaus).** [Histological Investigations on the Puncture made by the San José Scale (*Quadraspidiotus perniciosus*).]—*Pflanzenschutzberichte* **5** pt. 1–2 pp. 204–226, 12 figs., 24 refs. Vienna, 1950. (With a Summary in English.) [A more detailed account than one already noticed (*R.A.E.*, A **31** 373).]

Pant (G. D.) & Chatterjee (N. C.). **A List of described immature Stages of Indian Lepidoptera. Part I. Rhopalocera.**—*Indian For. Rec.* (N.S.) Ent. **7** no. 7 pp. 213–255. Dehra Dun, 1950. Price 2*s*. 3*d*. **Part II. Heterocera.**—*T.c.* no. 9 pp. 267–333. Delhi, 1951. Price 5*s*. 3*d*.